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FEBRUARY · 1947

Electrical Contracting

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE

NO. 5

Helpful Hints on Applying Capacitors

A Summary of the Applications of Capacitors in Industrial Plants

DO YOU HAVE A POWER FACTOR* PROBLEM?

If you are being penalized by a power factor or kva demand clause in your power contract, capacitors can save you money. By supplying your magnetizing current (kilovar) requirement at your plant by means of capacitors, the savings are always significant, frequently startling. It is not unusual for these savings to total more than the monthly demand charge. Your General Electric representative will gladly show you how these savings run.

THE USE OF CAPACITORS FOR RELIEVING OVERLOADED CIRCUITS

Very often, the judicious use of capacitors can solve an overloaded circuit problem in your plant. Capacitors reduce line load by supplying kilovars on the spot where magnetizing current is needed. Capacity increases up to 50 per cent have been reported following installation of capacitors; increases of 30 per cent and more are far from unusual.

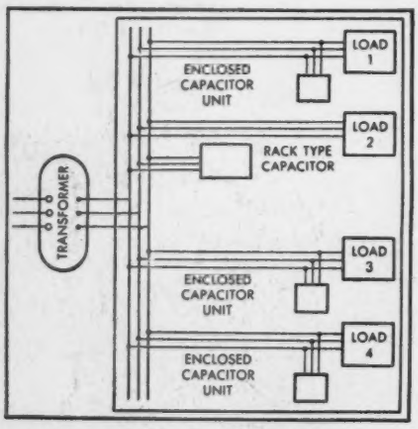

Fig. 1—Diagram showing application of capacitors in industrial plant.

THE USE OF CAPACITORS FOR REDUCING THE COST OF OPERATING RESISTANCE WELDERS

By inserting the proper capacitors in series in resistance welding lines, power factor improvement can be achieved which reduces the demand load by compensating for the welder reactance. This generally allows the feeder to handle either additional regular loads, or larger resistance welding loads, often without any replacement of wiring.

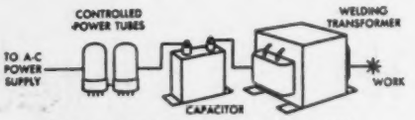

Fig. 2—Series installation of capacitors in welding circuit.

THE USE OF INDIVIDUAL CAPACITORS FOR MORE EFFICIENT MOTOR OPERATION

Low voltage, often due to overloaded circuits, causes excessive heating in motors, resulting, eventually, in breakdowns and burnouts. One remedy for this is the individual motor capacitor, consisting of one or more standard capacitor units, which may be mounted either directly on the motor frame, or near the motor. They are easily connected—either across the motor terminals, or across the terminals on the load side of the motor starter, but ahead of the overload protective device. Flexibility of installation makes these units ideal for power factor improvement in practically any type of plant.

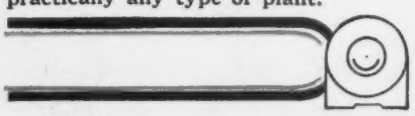

Fig. 3—This motor shows a reading of 10 amperes at 80 per cent power factor. Therefore only 8 amperes are being used for horsepower. The remainder represents reactive current, necessary to magnetize the motor.

Fig. 3 (b)—After capacitor is added to supply the kilovars, the line delivers only 8 amperes for exactly the same horsepower output.

CAPACITOR INSTALLATION RESULTS IN IMPROVED LIGHTING

Improved lighting is one of the main by-products of improved power factor. Properly applied, capacitors eliminate poor voltage conditions resulting from low power factor loads of motors, welders, transformers and other power equipment. This in turn does away with low light level and you get all the light you are paying for.

G-E application engineers will be glad to work with you in deciding whether capacitors can help your operation. Just call your G-E representative. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

★ ★ ★

* A large portion of modern industrial loads is made up of motors and other equipment which require magnetizing current, or kilovars, for their operation. These kilovars, together with the kilowatts required for useful horsepower output, make up the total demand from the power company's system. The term "power-factor" is used to designate the ratio of power current to the total current; thus the smaller the number of kilovars required, the higher the power-factor, approaching unity (100%) as a limit when kilovars equal zero. Average power factor can be expressed as the ratio of kilowatt hours to the total kva hours.

GENERAL ELECTRIC

PYRANOL CAPACITORS

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

Electrical Contracting

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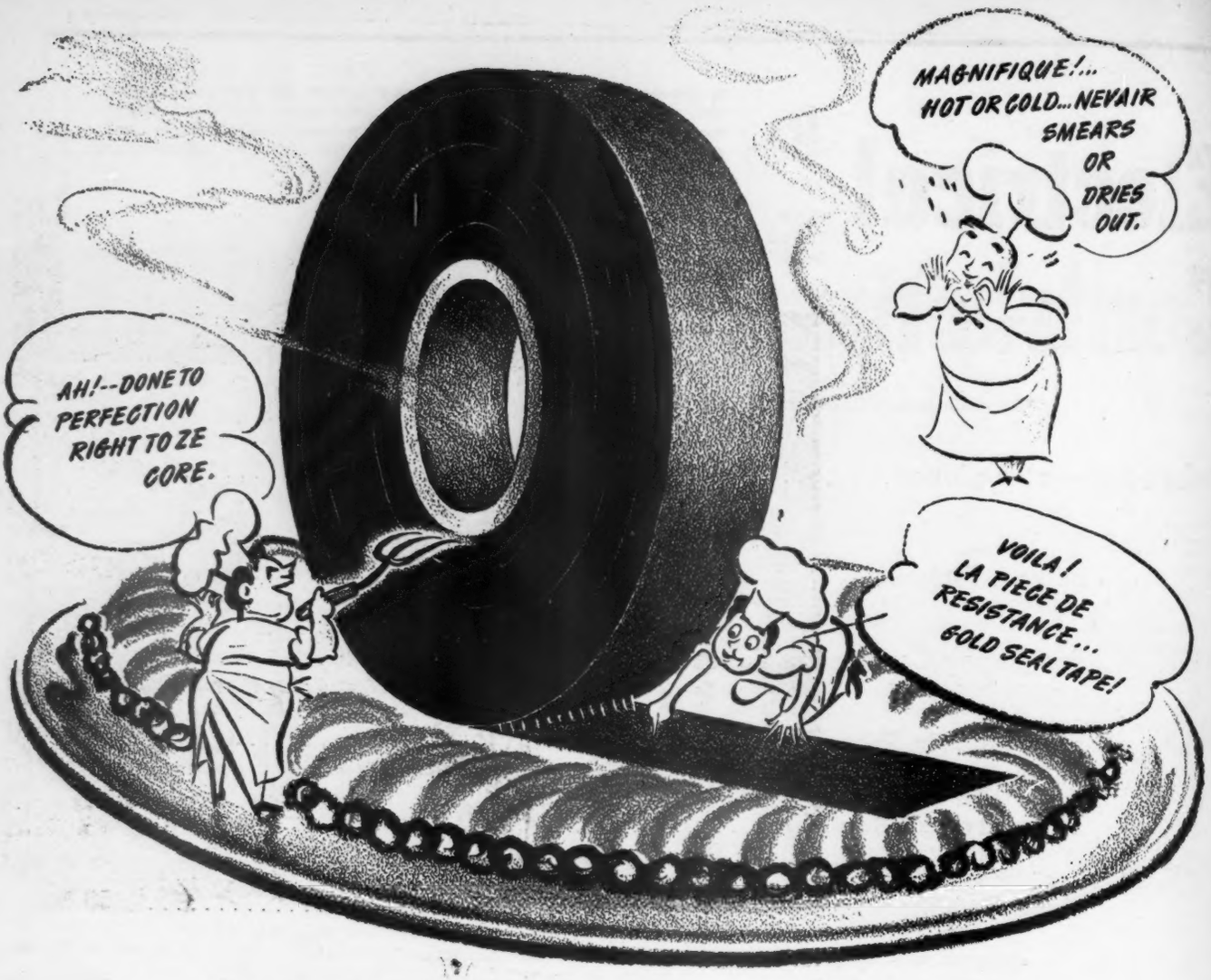
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FEBRUARY.... *at a Glance*

Type T

Thermoplastic building wires are performing exceptionally well under many conditions that have long been serious insulation problems. Glenn Koger of G. E. draws some interesting comparisons between type R and T wires in his article on "Type T Characteristics" on page 56.

Portal-to-Portal

Lack of enthusiasm by A.F.L. leaders for portal-to-portal suits does not mean that contractors may not some day have to face the issue although there is little likelihood of retroactive claims. Some contractors already consider such time. And some unions are likely to raise the question in new contract negotiations. The suggestion is clear in the policy announced by Green and Frey, that A.F.L. unions live up to existing contracts and any questions about how much of the workers time should be paid for is a matter of collective bargaining, not the courts.

Transformers

Selecting the right transformer for the particular application is often a toss-up between air and askarel insulated type. Each has important advantages. Or the more involved question often comes up as to where and how transformers can be used to the best advantage in industrial or commercial wiring installations. Solid background for such decisions will be found in the Industrial Electrification section this month, page 77, in the article, "Dry Type and Askeral Insulated Transformers".

Veterans Training

Electrical work involves a degree of skill and training unique among the skilled crafts. And the progress of the industry can be speeded or delayed by the supply of trained men we have available in the years ahead. Stark Electric Company is doing something about it. Veterans employed in the shop are enrolled in a comprehensive four year apprentice training course under experienced old timers, combining shop work with class room lectures. Charles and Guy Stark who own and operate the half-century old Baltimore concern organized the training program. "Veterans Train for Electrical Work" on page 60 tells the story. The ideas and methods are readily adaptable to other shop or community veteran apprenticeship programs.

Conversion

In Southern California 50 cycle power areas are going to 60 cycles over a two and a half year period. The changeover involves a huge job involving a vast amount of detailed work. California Electric & Maintenance Company has the contract, operates through the area in trailer shops. You'll find Henry Young's story about the project on page 49.

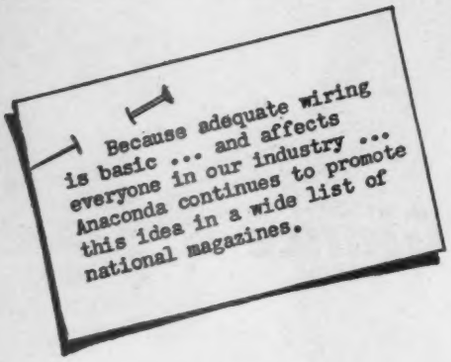
Farm Wiring

In the early days of rural electrification the folks along the high line routes talked about when they would have "the lights". Farm wiring jobs were cheap, inadequate, and limited to household uses. Electricity applied to farm production was inevitable, however, and today there are about 300 uses of electricity on the farm. That means a tremendous market for farm wiring in the years ahead. Next month, Middle West Editor Gus Eckel brings us a thorough review of rural electrification progress and an analysis of what it means as a market for electrical wiring and equipment. Watch for this in the March issue.

New Tools

Modern tools have made substantial reductions in fastening time where work must be done on masonry or steel in place. Carboloy drills, powerful electric drills and hammers, power driven saws and the like have practically eliminated hammer and chisel work. Now comes a new tool which drives inserts by the force of an explosive charge, reported to set fastenings as rapidly as it can be loaded. This is all to the good of the industry. The need for rewiring in existing buildings grows more acute every year. Fastenings are a major item of cost. And any cost cutting method cracks loose more and better jobs. Wiring made inadequate by new electrical utilization requirements is a major factor in building obsolescence.

He gets the FATTEST envelope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*WIRE AHEAD, a new booklet discussing preventive maintenance . . . the symptoms of inadequate wiring . . . and presenting plans for anticipating electrical demand, is now in preparation. We shall be glad to send it on request as soon as it is available.

ANACONDA from mine to consumer

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EDISON, PIONEER

TOM EDISON WORKED HARD. During the hectic years when his fertile brain and insatiable energy drove him to new achievements, his associates became known as the "insomnia squad". Twenty-four hour days were too short for the work that had to be done.

FORTUNATELY FOR US, that energy sprung from an abiding confidence in the future. If an invention could save labor, add to convenience or just do the job better, it was worth while, people would use it and it would eventually take its place in the industrial or home life of the community.

EDISON'S AMAZING GENIUS for invention had the practical slant of the pioneer. His work on the carbon filament lamp which gave us our first commercially practical incandescent electric light is well known to every school child. But in addition he invented a complete distribution system, including dynamos, conductors, fuses, meters, sockets and numerous other devices. Of the 1097 patents granted to him during his lifetime, 356 dealt with electric lighting and power distribution. To Tom Edison it was not enough to invent a startling new device. It had to be brought within the reach of the people.

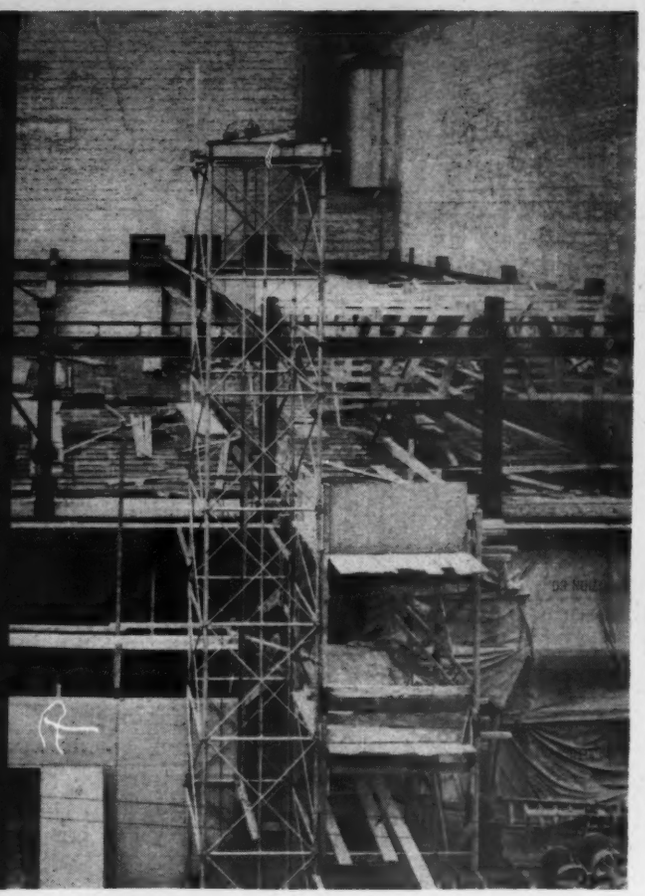
THE GREAT PIONEER was born a hundred years ago this February 11. The Thomas A. Edison Centennial is being celebrated throughout the country. Great banquets, civic ceremonies and yards of newsprint will do honor to the man who literally changed our ways of life. It is a memorable occasion in which we are proud to participate. Those of us in the electrical industry are the beneficiaries of a great heritage.

IT IS A GOOD TIME, TOO, to take stock of our stewardship, to push aside for a moment the tasks which take our time and restrict our horizons. Why not try to appraise our own future with some of the vision and confidence of the great inventor? Though we cannot tap his fountain of inventive genius, we may find the way to his tremendous resources of energy which have contributed so much to the electrical industry.

TOM EDISON LIVED until 1931, long enough to see many of his early inventions outstrip his own dreams. His early lamp looks meager indeed beside a modern lighting job. The early power generating plants, masterpieces of craftsmanship, are quaintly ineffectual against the giants that serve our cities today. Yet these were pioneer projects created without the historical perspective to give a yardstick of probable growth. It took great confidence then. How far could we go now, with the same pioneer spirit plus the confidence of a clear pattern of continuing growth in the industry and its service to the public? We can answer pretty much as we will.

Wm. F. Stuart

For that building you're going to wire ...



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Frequency Conversion TAKES Skillful Organization

How California Electric & Maintenance Co. handles residential 50 to 60 cycle conversions in Southern California — a two-and-a-half year contract.

By H. W. Young

1—*Advance man meets housewife. Contractor's advance man obtains exact information.*

CONVERSION of the whole system of the Southern California Edison Company from 50 cycles to 60 cycles is now under way, an operation that will cost the Company in the neighborhood of $27,000,000. The work on customer equipment is divided into various customer groups, such as domestic and small commercial, large commercial and industrial, electric clocks, etc., and contracts have been let for its accomplishment.

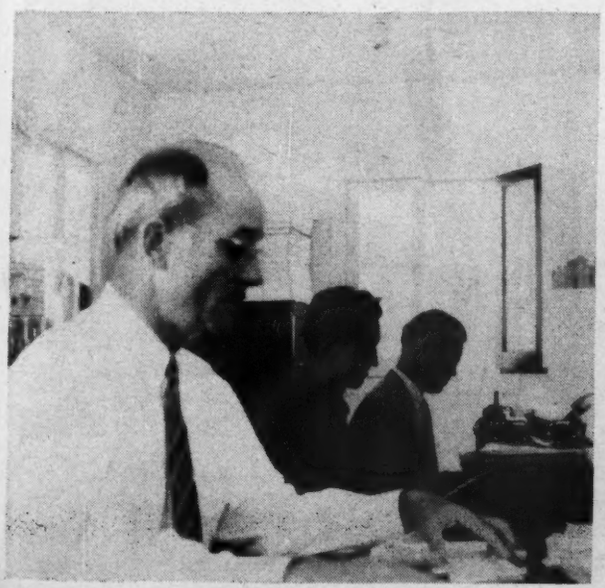
Among the largest of the groups in point of number of customers and general complexity of the problem is that of the domestic customers. This group contains approximately 650,000 customers, from Santa Barbara on the west, north to Lancaster, east to Beaumont and south to Laguna Beach, including all rural as well as city customers.

Contractor Organization

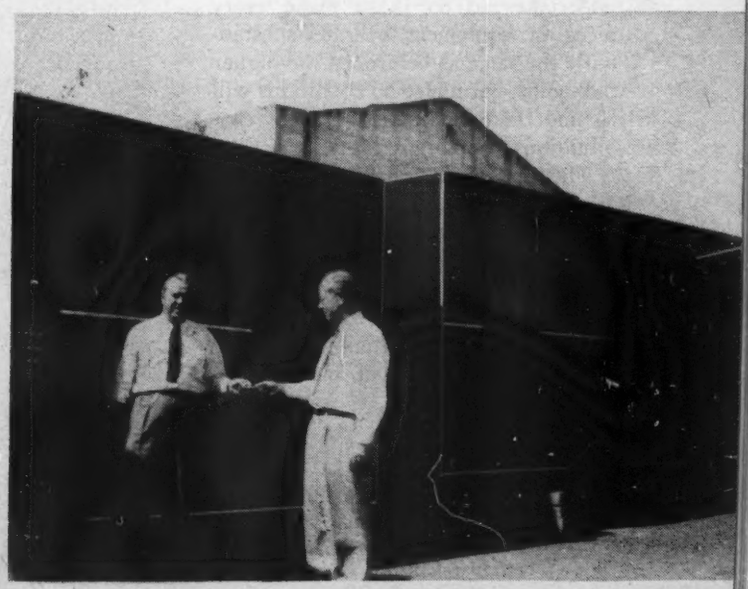
The contract covering the conversion of this domestic group was let to the California Electric & Maintenance Co., Los Angeles electrical contractor. J. B. Shamel, president of this company, was formerly president of the Shamel Electric Co. His project manager is Bob Lee, formerly with the Newbery Electric Co. and during the war on government projects in the Pacific Islands. The contract was made July 9, 1946, and is to be completed in two and one-half years, with a six-months' extension clause. The value of this one contract may amount to $1,500,000.

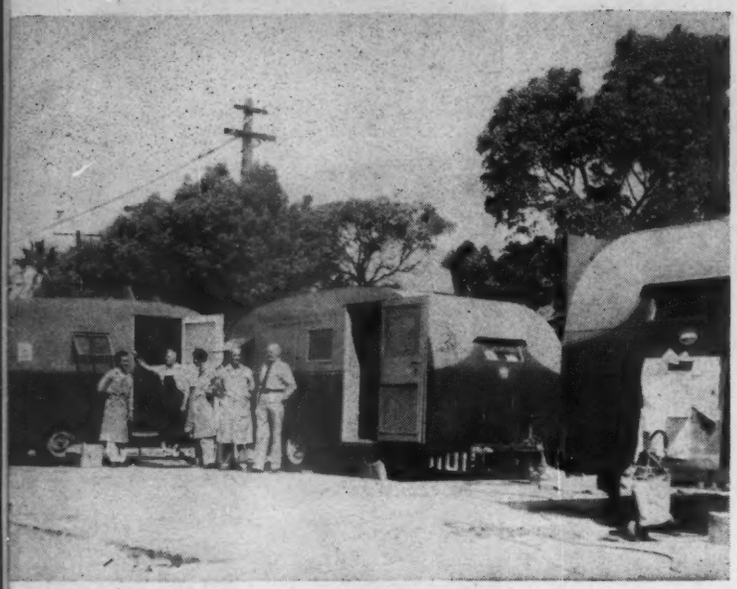
How the California Electric & Maintenance Co. is handling its end of the vast undertaking is decidedly interesting from the standpoint of contractor organization and practice. On this contract, every item of equipment in the homes that would be adversely

2—*Cards are processed in superintendent's trailer as project moves over territory.*



3—*Jack Carberry, coordinator, and Otto Wenkler, dispatcher, by the office trailer.*





4—*Work is handled from six trailers; two phonograph repair, one motor repair, two office, one emergency.*

5—*Motor repair trailer handles minor motor changes, in specially equipped shop.*

affected by the change in frequency—principally items involving motors—must be adjusted, usually by changing the speed ratio, through belt or gear rearrangements.

The problem is further complicated by the myriad differences in make, type and age among literally millions of pieces of electrical equipment. The contractor is buying all the necessary material and parts, and it will be necessary for him to carry an estimated $200,000 stock of such parts to meet the diversified needs. Factories have been prepared to some extent to meet the demands, having known of the Edison Company's intention for a long time. Buying will be conducted where possible through franchised repair part sources and through wholesalers and distributors. In cases where it is utterly impossible to obtain certain obsolete parts on the market, they will be manufactured by outside shops, the contractor maintaining no manufacturing facilities. What the contractor undertakes to do is to make every piece of equipment operate substantially the same as before, on the higher frequency, but under no conditions will he undertake any other repairs, rehabilitations, "tune-ups", etc.

The Edison Company has divided its territory into nine districts or areas. These areas have been or will be surveyed by them by the time the contractor arrives. The information for each customer, as to make, type, etc., of each piece of equipment owned by the customer is put on machine-punched and sorted cards, which are furnished to the contractor as the basis for his conversion activities.

Two separate field operating units will be maintained on the job by the contractor. One unit is now operating in Santa Barbara and the other is being organized. Each unit has its own personnel and supervision and each will be fully equipped, with approximately 15 trailers to serve as supply depots. The trailers are a uniform type, built for this purpose.

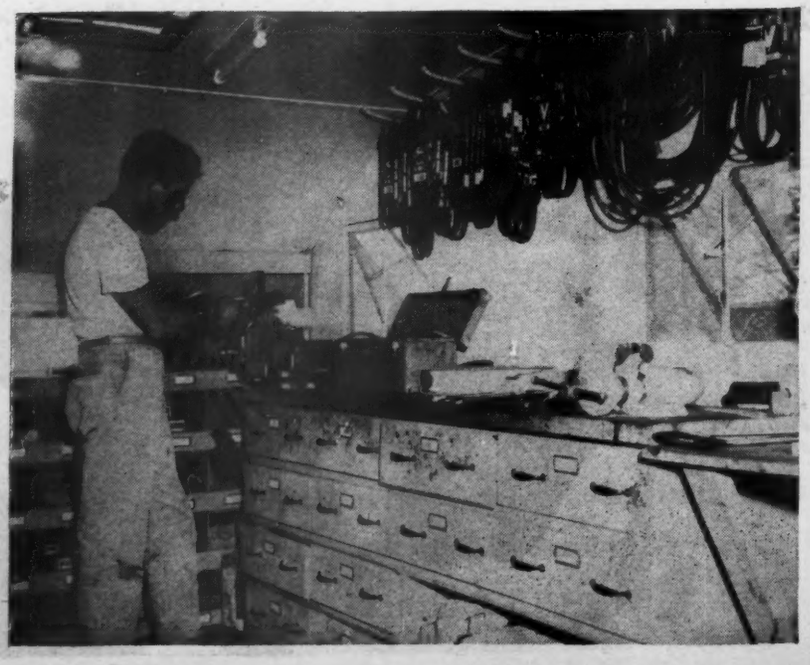
Changes required in refrigerators will be made in the home, as will be pulley and belt changes in washers. Washers requiring gear changes, however, will be brought to gear shops established in various localities by three stake-body trucks equipped with hydraulic lifts and operated by two-man crews.

Bushing changes in record players also will be made in the home, but players requiring other adjustments will be picked up by small trucks and brought to a mobile shop consisting of two trailers.

The gear shops of each unit will be served by a single stock truck plying back and forth between them and the stock warehouse, keeping the former supplied with materials and parts, this stock truck delivering to a disbursing trailer attached to each shop and acting in the capacity of a small "branch" warehouse. There are also two mobile trailer offices attached to each unit.

Supplementing the field shop activities are a number of pick-up serv-

8—*Interior of refrigerator and washing machine repair parts trailer.*



6—*Washing machines which require gear changes, are all brought into a central point.*

7—*Phonographs are altered in a trailer specially equipped for this type of work.*

ice trucks, each manned by two experts in all phases of the work, and prepared to undertake special assignments involving unusual conditions or difficulties.

All customers in an area in which a unit is to operate are notified by the Edison Company somewhat in advance and told what is to take place in the near future. The contractor must then operate on a close and exacting schedule. The punched cards as they come to the contractor contain fairly accurate information as to the equipment to be found in each house, but it manifestly cannot be wholly accurate because much of it had necessarily been furnished by the customers themselves and often their knowledge is somewhat uncertain as to date of equipment, model, etc. What the contractor must have is exact information on every piece and that information not more than a day or two old, so that when the men go into a place they will know just what is to be done, have the parts ready and clear up the conversions expeditiously and completely, for the whole plan would be bogged down if repeated call-backs had to be made.

Advance Survey

It is therefore necessary for the contractor to make his own physical survey just prior to the arrival of the mobile shop. Special advance men are employed for this purpose, each generally able to do the advance work for one or two crews. These men can at the same time usually see to it that somebody will be at home when the crew arrives.

To assist in the conversion work, the Edison Company has prepared what is known as the "Data Book" containing information on the changes necessary on all kinds of equipment and practically all types and models. Two of these books are supplied to each unit.

Punch Card Record

At the end of each day's work, the unit has a large number of the punched cards that can be marked complete. There is one expediter in each unit. Working that night, he processes the cards, completes the contractor's records and returns the cards to the Edison Company the next morning for machine sorting and filing.

The expediter also gets ready a new set of cards for the survey man, whose work is a day in advance of the physical operation.

Another feature of the contractor's office work is the maintaining of a separate card file on which everything in the way of material and parts put into the individual customer's job is entered as well as everything in salvage parts taken out, which information is made available to the Edison Company.

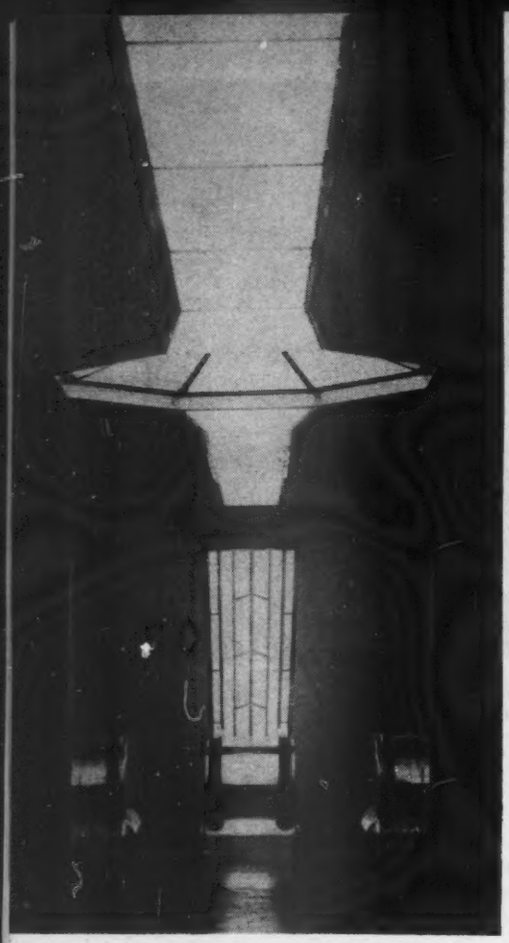
The contractor expects that a total of approximately 200 men will be employed on the work for the life of the contract.

9—*Stock truck feeds trailers from central warehouse with necessary change over materials.*

FLOW LINES IN Showroom Lighting

Custom fixtures combine decorative architectural effects with efficient sales lighting in New York auto display salon.

By Hugh P. Scott



Escalators from main salon are lighted by vaulted arch of special glass shielding four continuous rows of fluorescents (C). Upper lobby is decoratively lighted by flat dome (H) that houses radiating 24-inch lamps.

CUSTOM-TAILORED fixtures, applied in an effective lighting plan, are an important part of the sales program successfully practiced in the Chrysler International Automobile Salon, Chrysler Building, New York City. Sound lighting principles and smart craftsmanship are combined. Flowing lines of light are employed to mold the streamlined cars. Highlighting attracts and directs the eyes of prospective buyers. Careful control gives high-intensity glare-free diffusion without harsh shadows or heavy contrasts.

Unique to New York's sales-conscious Grand Central area, the policy of the International Salon is to create a desire to buy through effective presentation, demonstration, exhibits, settings and lighting. Personal pressure is at a minimum, prospective customers being referred to local dealers for actual sales.

In creating a forceful setting for this approach, Chrysler has included in their New York salon a slowly-revolving six-car turntable. Escalators carry customers to the second floor showrooms. Reflection-free, curved horizontal-axis show windows allow a clear view from the streets. Stainless steel and chromium plate are used for structural and ornamental decoration and the area is completely air conditioned.

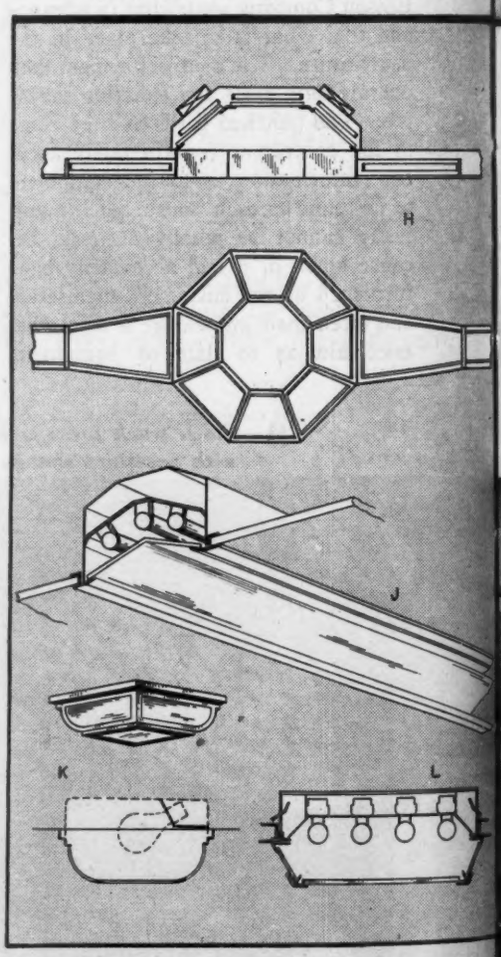
In designing the lighting plan, several factors introduced specific problems. All display area lighting fixtures were to be recessed into an existing ceiling already crowded with structural beams, steam pipes, water mains and air conditioning ductwork. The apparent height of the second floor ceiling was to be increased. Vertical lighting was desired to illuminate the flanks of the car. Reflections were to accentuate the sweeping horizontal lines of the models.

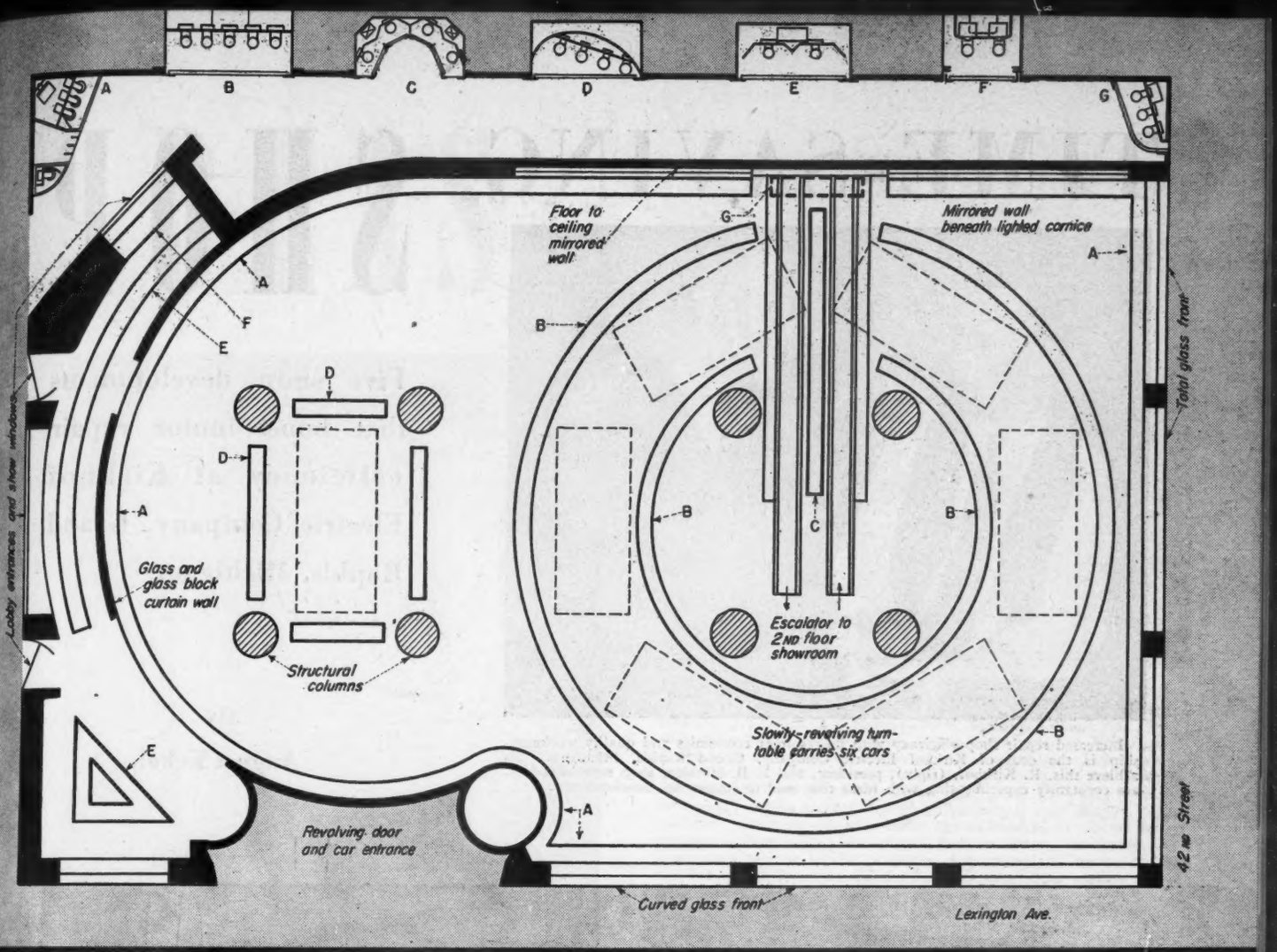
To achieve a recessed installation it was necessary to tailor lamp housings to fit available space, often notching frames to clear pipe lines, relocating ballasts, varying the depths of housings and recessing some fixtures into existing air duct enclosures.

To supply both air and illumination, a dual-purpose lighting fixture and air duct was created and installed as a continuous cornice around salon walls and over show windows. This special fixture (detail A), combining straight runs with multi-radii curves, outlines the salon area with twin ribbons of light, illuminates the ceiling, circulates tempered air and creates the desired strong vertical light component. Conditioned air passes from wall-hidden ductwork through a 4-inch louvred gap beneath three lines of fluorescents and above a single row of similar lamps.

Dominating the floor plan, a huge turntable carries six cars from the Chrysler-DeSoto-Dodge-Plymouth lines around a centrally-located raised platform, past the convex, reflection-free show windows and beneath the stainless steel escalators. Recessed into the ceiling directly over the inner and outer edges of the moving platform are concentric circular bands of high

[Continued on Page 139]





Second floor entrance lobby receives decorative treatment through flat dome, back-lighted by radiating 20-watt white fluorescents (H). Upper showroom receives high-intensity general illumination from multi-purpose, inverted V, recessed continuous trough (J). Offices and conference rooms are lighted by both incandescent luminaires (K) and partially-recessed fluorescent fixtures (L).

Combination lighting fixture and air conditioning duct outlines salon with continuous cornice treatment (A). Recessed circular bands of five-row 50-watts-per-foot fluorescents top-light moving cars on large turntable (B). Escalator to second floor is illuminated by continuous lighted arch (C) while inclined banked lamps (D) create strong vertical lighting component for side detail. Other special functional designs illuminate desk, entrances (E), interior show windows (F) and wall display (G).

Primary source of general illumination in upper showroom is from continuous trough with inverted V glass panels (J). High vertical component of light is produced to strongly illuminate polished sides of displayed cars. Raised central construction creates optical illusion of increased ceiling height.

Brush-stroke treatment is applied to sweeping cornice (A) and overhead circular turntable troffers (B). Combination of fixtures A and B illuminates moving cars with 140 watts per linear foot. Banked lamps in recessed runs (D) have function of diffused floodlights while curved glass panel under escalator (G) maintains continuity of cornice treatment.

TIME-SAVING SHOP

Increased repair shop efficiency with its resultant economies and quality workmanship is the goal of Kirkhof Electric Company, Grand Rapids, Michigan. To achieve this, R. Kirkhof, (right), president, and L. B. Hinkley, shop superintendent, are constantly experimenting with ideas that lead to interesting developments.

Five shop developments that boost motor repair efficiency at Kirkhof Electric Company, Grand Rapids, Michigan.

By
August Eckel

FIG. 1. DUAL ELEVATOR for small parts and motors (Fig. 1A, 1B). With the sales area on the first floor and shop on the second, this device speeds handling of small work. Each elevator is a section of roller conveyor which tips slightly at platform position so trays of parts roll off onto "pickup" rolls. Conventional limit switches stop cages at pickup points; also prevent jamming of trays on pickup rolls. Ordinary ¼-ton "Budgit" hoist (Fig. 1C) provides motive power, operating long roller chain connected to each cage. There is always a cage at top and bottom platforms.

IDEAS

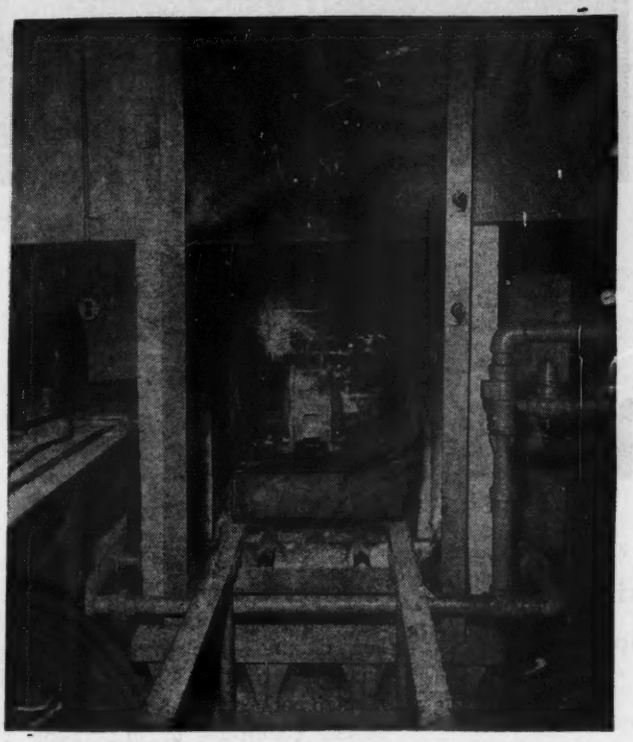


FIG. 2. GAS-FIRED BURNOUT OVEN large enough to take a 300-hp. stator. Heavily insulated steel door encloses 27" x 45" x 47" fire-brick lined over. Dolly on channel-iron track rests above oven jets burning mixture of air and natural gas. Burn-out time for 5 to 10 hp. stators—25 to 30 minutes; smaller units—10 to 15 minutes. Exhaust system removes combustion gases.

FIG. 3. SAND BLAST ROOM for cleaning large parts and stators. The 6-ft. by 6-ft. by 8-ft. totally enclosed area is fully lined with sheets of Transite with protective rubber sheeting covering wall opposite nozzle. Entire floor is a grate of 1-in. solid steel rods with hopper underneath to catch sand for reuse. Inverted angle-iron on grate forms track for dolly with grooved wheels. Ice-tong hook and bar brackets in center are fastened to a twisted square steel rod which is raised or lowered (while turning slowly) approximately four feet by ¼-hp. gear head motor above room. Hook can be lowered to pick up heavy equipment from dolly. Nozzle (air pressure 100 to 120 lbs./sq.in.) is attached to long handle extending through wall of room; can be directed up or down or sideways. Large plate glass window above nozzle plus reflector flood lights in room permit operator to watch blasting operation. Sliding door encloses room during blasting. Sand, pulverized too fine for use, goes up through exhaust vent.

FIG. 4. TWIN BAKE OVEN combining infra-red heat for small equipment and conventional electric heat for motors of larger size. Walk-in oven (5-ft., 4-in. by 6-ft. by 8-ft.) with 3 kw. of heating units on side has built-in infra-red oven (30½" x 47" x 64" deep) housing 16—250-watt infra-red lamps (eight per side) in 8-in. recesses at bottom. Walls of small oven are 4 inches thick; filled with rock-wool insulation and covered with Transite sheets. For large equipment (motors up to 500 hp. in size) hinged top of small oven is opened and both types of heat used. Both infra-red and resistance heating elements are controlled by a single time clock, each type being placed in circuit manually. Temperatures up to 350 degrees F. can be obtained in either oven.

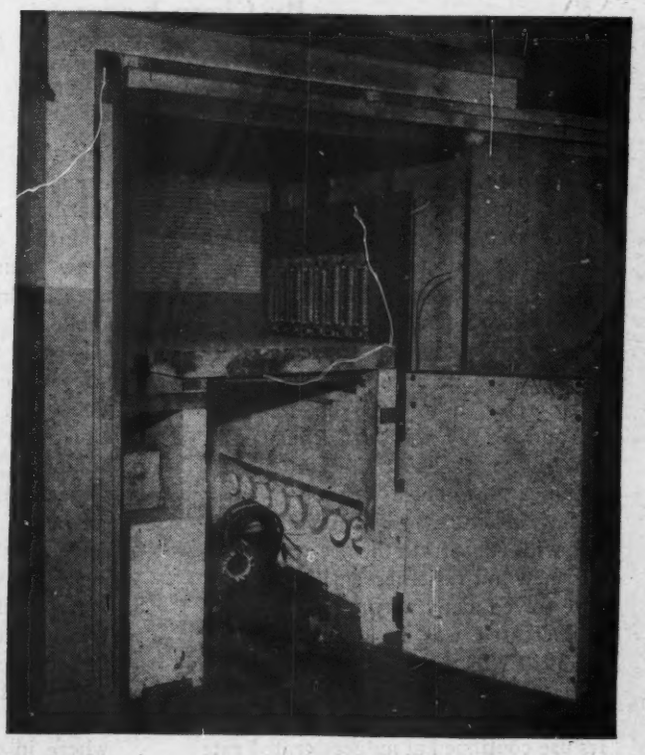
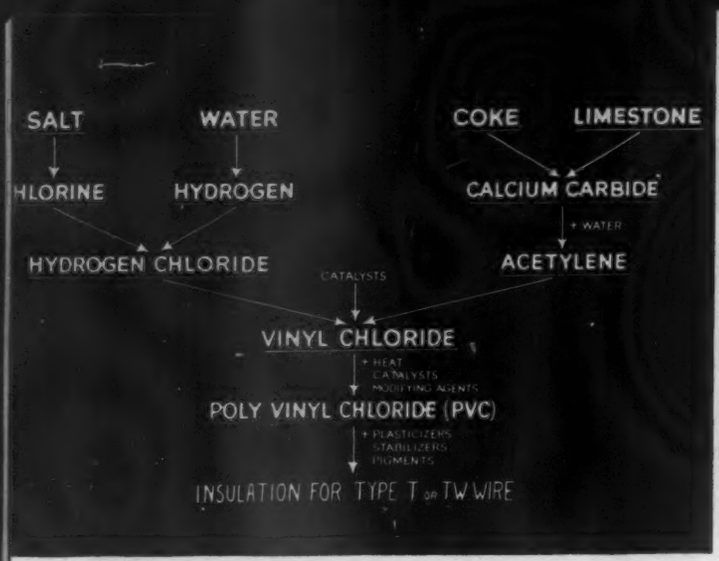
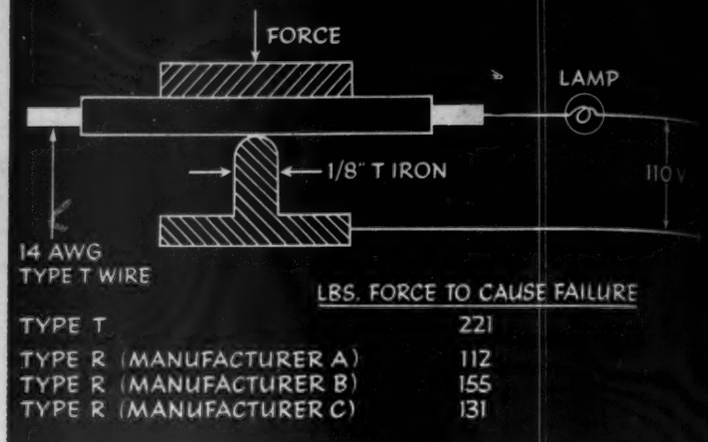


FIG. 5. SPRAY BOOTH GRINDER of the flexible shaft type on trolley mounting permits quick "dressing up" of stator laminations and other buffing operations.



1—Chemical sources of insulation for Type T and TW wires.



	LBS. FORCE TO CAUSE FAILURE
TYPE T	221
TYPE R (MANUFACTURER A)	112
TYPE R (MANUFACTURER B)	155
TYPE R (MANUFACTURER C)	131

2—Compression test weights wire against round edge to breakdown.

Type T Characteristics

How thermoplastic insulated building wires compare with Type R in dimensions and application.

By Glenn Koger

Designing Engineer, Wire & Cable Division, General Electric Company

THE WIDE acceptance that thermoplastic wires have gained during the war years and the extended recognition given these wires by the Electrical Committee of the NFPA, have brought about the need for a better understanding of the characteristics of this wiring material.

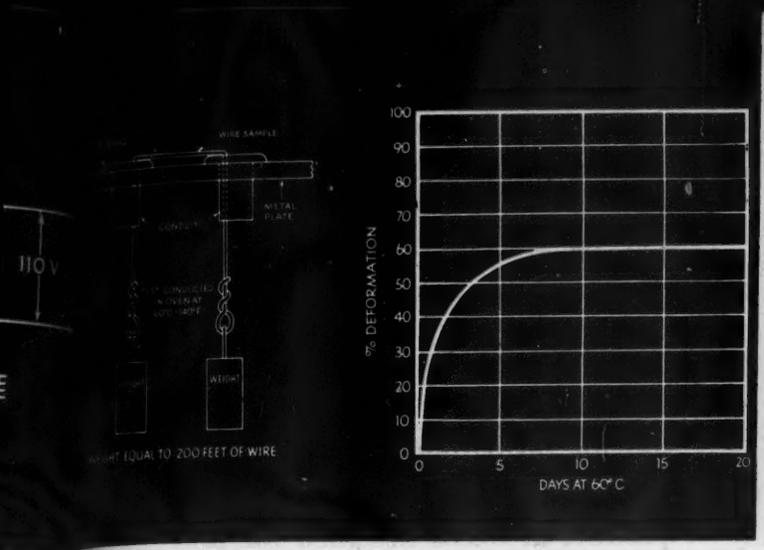
Thermoplastic insulated wire (formerly referred to as Synthetic Type SN and SNW) was first developed in 1935, not as a substitute for rubber-insulated wire, but as a new type possessing desirable properties not available with rubber. In the pre-war years, this new oil-resisting small diameter wire solved many wiring problems and so increased was its demand that in the 1940 N.E. Code it was recognized as a small diamater wire which could be used in rewiring existing raceways. Its use continued at an accelerated rate until the issuance of the Rubber Restriction Order of April 1, 1942, when, with the loss of crude rubber, the production of the thermoplastic wires sky-rocketed. It was found that the thermoplastic insulation could easily replace rubber in many applications. Also, that here was a product, already developed, that could be manufactured from raw materials obtainable in abundance in this country.

The following general rules for the use of Type T and TW wires (thermoplastic) were adopted by the Electric Committee:

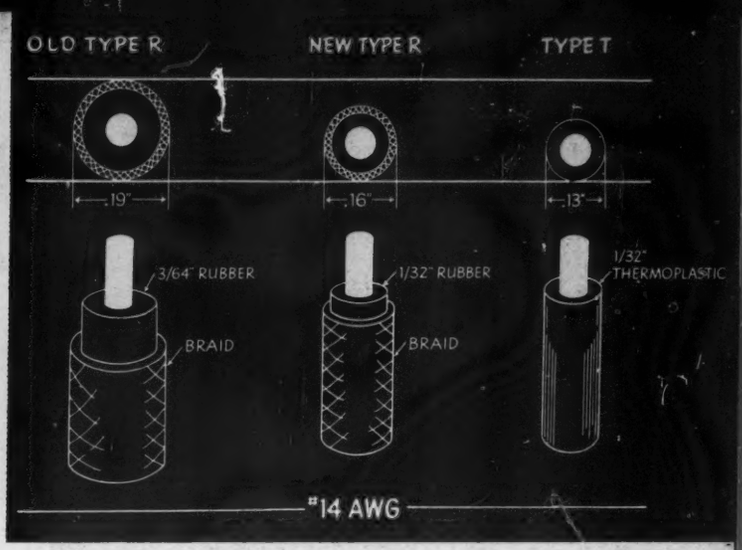
1. Open wiring in sizes up to 2 million C.M.
2. General use, including armored cable and non-metallic sheathed cable, in sizes up to and including 4/0 Awg.
3. New work in conduit or electrical metallic tubing was installed in accordance with Table 4 of the 1940 Code.
4. Rewiring in existing raceways, where installation may be in accordance with Table II of the 1940 Code.

By the time Interim Amendment No. 46, approved May 7, 1942, by the Emergency Committee gave the first "general use" approval to thermoplastic wire, much experience had already been obtained through the use of large quantities of this wire in industrial plants, both old and new, and under severe conditions of installation and service. It is also worthy of note that the services, Navy, Army and Signal Corps, used tremendous quantities of thermoplastic insulated wires but in no case were these wires approved until exhaustive tests had found the wire to be satisfactory. The Navy specified thermoplastic insulations on shipboard cable in preference to rubber as early as 1937.

In this rapid growth of thermoplastic insulated wires there have been many types and kinds of materials placed on the market, but only two basic types, polyvinyl chloride polymer and vinyl-chloride vinyl-acetate copolymer have gained general recognition. It is impossible to determine the difference in thermoplastic insulated wires by visual inspection, therefore, a word of caution may be helpful. Always make certain that the coils or reels you purchase have an Underwriters' Laboratories label on the carton or tag. This certifies to you that the Underwriters' Laboratories has inspected this manufacturers' wire and has approved it for use as permitted under the rules of the National Electrical Code. Furthermore, this label assures you that the wire has been properly



3—Deformation test weights wire at sharp angle over metal bushings.



4—Comparison of insulation thickness for old Type R, new (1947 Code) Type R and Type T.

tested in accordance with Underwriters' Laboratories Standards which have been designed to permit only satisfactory wire to reach the market.

The physical and electrical characteristics of these thermoplastic insulations are regulated to a major degree by the type and quantity of the plasticizers, stabilizers and pigments that are compounded with the basic resin. It is possible to design compounds that are especially adapted to special conditions. For low temperature applications the proper quantity and type of plasticizer is chosen to give the insulation good flexibility at low temperatures. Much research and study have been directed toward the development of a compound which has both low temperature flexibility and good resistance to deformation at high temperatures. Some degree of success has been realized, but it is characteristic of these materials to soften and deform more easily at the high temperatures as the flexibility at low temperature is improved. For this reason, some manufacturers have chosen to insulate their wires with the harder insulations which are more resistant to high temperature deformation. The N.E. Code permits the use of thermoplastic insulated wire at temperatures up to 60°C. (140°F) and all Underwriters' approved thermoplastic wires perform very satisfactorily at or below this temperature.

All approved wires must pass a deformation test which is conducted at 121°C (250°F). This and other tests have shown that none of these approved insulations will flow or run together at temperatures of 150°C (300°F). However, some insulations flow at temperatures slightly above this, and all thermoplastic insulations now approved flow together at 190°C. (375°F). In contrasting this performance with rubber insulated Type R wire, which is of the thermosetting type, it can be shown that temperatures as high as 260°C (500°F) have been encountered for very short periods of time without completely destroying the Type R wire. In this respect, which admittedly are abnormal conditions, the thermosetting insulations are superior to the thermoplastic type.

Many tests have been made to determine the flow characteristics of thermoplastic insulations. These tests plus field experience have shown that the deformation which occurs at pressure points progresses with time up to a certain point after which it remains constant. In other words, the deformation is dependent upon the force and temperature, but under constant pressure and temperature the deformation does not progress, as is clearly shown in Fig. 3.

Where the operating temperatures do not exceed 60°C (140°F), the insulation on the approved Type T and TW wires is almost ageless. There are some Type T wires that have been specifically designed and approved by the Underwriters' Laboratories for use on switchboards or within appliances or machine tools where the temperatures may reach 80°C (176°F). In general, however, years of exposure at these abnormally high temperatures produce some stiffening of the insulation. This is not serious where the wires are not subject to flexing. Tests have shown that the electrical properties generally improve under such conditions of aging.

The extreme chemical stability of the polyvinyl resins makes this insulation unusually weather resistant. This is especially true of the Type TW wire, where the ingredients used in compounding the insulation have been especially chosen for their moisture-resistant properties. Field installations and laboratory tests have thoroughly demonstrated this feature. Type TW wires can be safely installed in continuously wet locations such as those referred to in Section 3102 of the 1947 N.E. Code. Tests have also shown that conduits containing Type T or TW wire can be filled with water and frozen solid at —40° without injuring the insulated wires. Care should be taken, however, to see that the thermoplastic wires are not subjected to any great amount of flexing when the temperature is below —10°C (14°F). The insulation becomes quite brittle at these temperatures and may crack when bent. However, normal and reasonable flexing of the wires due to weather conditions encountered in outdoor installations does not damage the insulation.

An outstanding feature possessed by many of the Type T and TW wires is their excellent resistance to oils. It was because of this feature that the Underwriters' Laboratories gave its first approval of this wire in 1939 when it was "approved for use in recognized metal raceways where exposed to oil and at temperatures not exceeding 60°C as permitted in Section 3004h of the 1937 edition of the National Electrical Code". It should be noted, however, that a Type T or TW wire when used as building wire need not possess oil resisting characteristics. It was for this reason that in recent years the Underwriters' have approved some Type T and TW wires that do not have this feature. Therefore, it now becomes

[Continued on page 112]

CURING

Reducing curing temperatures of silicone insulating varnishes makes it possible to process this heat-stable product in ovens designed for low-heat organic impregnating.

FIG. 1—Oven designed for curing organic insulating varnishes may be used in processing heat-resisting silicone products. Equipment is preheated to insure absence of residual moisture, pre-cured to evaporate the solvent, and baked at 300 degrees F. to polymerize the synthetic varnish.

FIG. 2—While still warm from preheating, motor is dipped in vat of silicone impregnating varnish until all bubbling ceases. Vacuum impregnation is also an approved method. To secure true heat-stability, only inorganic materials should be used for insulation.

PRIOR to the introduction of silicones, electric apparatus depended upon two general dielectric classifications—varnishes, plastics and cements in the organic group; and asbestos, quartz, glass and mica among the inorganic materials. Lacking high heat stability, the effectiveness of the first group was limited by temperature rise. Possessing this stability but also characterized by hardness and brittleness, the second group likewise had definite limitations as a universally-applicable insulating product. The research which resulted in developing the silicone family was prompted by these limitations and the necessity in the electrical industry for an impregnating resin capable of withstanding higher temperatures than was possible with ordinary varnishes.

The silicone family includes liquids, greases, compounds and rubber-like materials in addition to the resins. The silicone resins, chiefly used for electrical insulation, are of prime interest to the electrical industry. As the name suggests, silicones are produced from silica or sand in chemical combination with carbon, hydrogen and oxygen which are included to provide chemical versatility in control and liquefaction.

Thinning is by conventional means and the dipping or impregnating application is performed while the equipment receiving the insulation is warm. This warmth is created by preliminary baking which completely removes all residual moisture. In curing, two steps complete the cycle. The first step consists of evaporating the solvent, since all traces of solvent gasses must be completely eliminated to avoid the possibility of surface bubbles which, if later punctured, would leave uninsulated craters. The time factor of this step depends upon the physical size of the parts being processed, the number of dipping-baking cycles contemplated and the depth to which the varnish must penetrate. Controlled temperatures and ample ventilation should be maintained to guarantee thorough processing and safety. The second step,

SILICONES

FIG. 3—Motor should be removed from varnish and allowed to drip for several hours prior to baking. Complete elimination of unabsorbed varnish often requires three or more hours.

involving a higher temperature, cures or polymerizes the synthetic.

Since heat stability is an outstanding characteristic of silicone varnishes, it was initially supposed that temperatures higher than normal would be required for drying and processing. While at first true, the requirement of super heat is no longer necessary and ovens designed for organic varnish baking can be successfully employed. The Dow Corning Corporation of Midland, Mich., prescribes 300 degrees F. as the necessary temperature to cure their silicone varnish designated as DC 996. Their recommended cycle includes pre-baking to completely remove residual moisture, vacuum impregnation of the apparatus or dipping while warm until all bubbling ceases, and drainage for at least three hours to eliminate surplus varnish not completely absorbed. After the apparatus is baked at 160-195 degrees F. (70-90 degrees C.) until the solvent is evaporated, the equipment is cooled to room temperature and the dipping-baking step is repeated either once or more times, depending on the desired thickness of finished coat. After the final pre-curing at 160-195 degrees F., the temperature of the oven is increased to 300 degrees F. (150 degrees C.) and maintained at this higher level for 6 to 12 hours, depending on size and construction of the equipment being treated.

Manufacturers of DC 996 state that the dry dielectric strength is between 2500 and 3000 volts per mil by ASTM D115 Short Time Test, and approximately 20 percent below this figure when tested wet. Water absorption is less than 0.1 percent after 24 hours and 0.15 percent after seven days. It is recommended for use on equipment which is to be operated at temperatures up to 175 degrees C. (347 degrees F.).

Where normal operating conditions are encountered, the use of silicone insulation has little or no physical advantage over organic products and their higher cost does not promote general application. However, under abnormal conditions of heat, humidity, corrosion and wear, when rugged service is demanded of electrical equipment, their physical and economic values become strikingly apparent. In these cases, higher outputs have become possible for given sizes of motors, there is greater freedom from overload failure, higher temperatures may be carried safely in windings, insulation life is prolonged and the hazard of fire is reduced to a minimum. Because the materials are unaffected by heat at which organic insulation would burn, the silicone resins have given increased reliability, life and safety to electrical equipment operating under adverse conditions.

Because silicone insulation does not carbonize when overloaded and resistance to moisture is maintained even after long periods of aging at elevated temperatures, it is reasonable to say that a silicone motor will outlast one conventionally insulated. To achieve the full purpose of high heat stability, the use of silicone varnishes should be in conjunction with only inorganic materials (glass, mica and asbestos) bonded and/or impregnated with silicone resins.

Specifications for rewinding a-c induction motors with silicone insulation, recommended by Dow Corning, also state that, in addition to using silicone varnishes for all bonding operations; silicone rubber, lubricants and paints capable of withstanding continuous operation at 200 degrees C. should be used. Solder should melt above 285 C.

All other components should consist of silicone-glass or silicone-glass-mica combinations or any other inorganic material capable of withstanding 200 degrees C. continuously.

No organic materials, such as friction tape, scotch tape, organic sticking varnish, cotton tying cord or paper should be used.

Manufacturers of new equipment and motor repair shops rewinding old equipment should give serious consideration to this relatively new varnish when insulating machines to be subjected to endurance marathons. Inside hot air ducts, on top of drying ovens, in the tough atmosphere of steel mills, in humid textile plants, for mining equipment and other apparatus designed for rugged service, silicones are earning their service stripes and establishing performance records.

VETERANS TRAIN

Enthusiastic students learn while they earn, in four-year approved veterans electrician apprentice course, sponsored by Stark Electric Company, Baltimore.

By
Berlon C. Cooper

Out of Army khaki and Navy blue, youthful veterans form the second freshman class (1946) in the Stark Electric Company training program for electrician apprentices. John W. Depser, expert electrical serviceman and long-time company employee is first-year class instructor.

During four-year training, apprentices work on all types of electrical equipment, from fractional motors to large, heavy equipment.

No task is too small or too large, too simple or too complicated for apprentices. Experience in all types of work is required as part of the program.

ELECTRICIAN apprentices, mostly veterans, are now working while studying, in a four-year approved electrician apprentice school in Baltimore. Now in its second successful year of operation, it is sponsored and conducted by Stark Electric Company, leaders in industrial electrical service in Maryland for nearly fifty years.

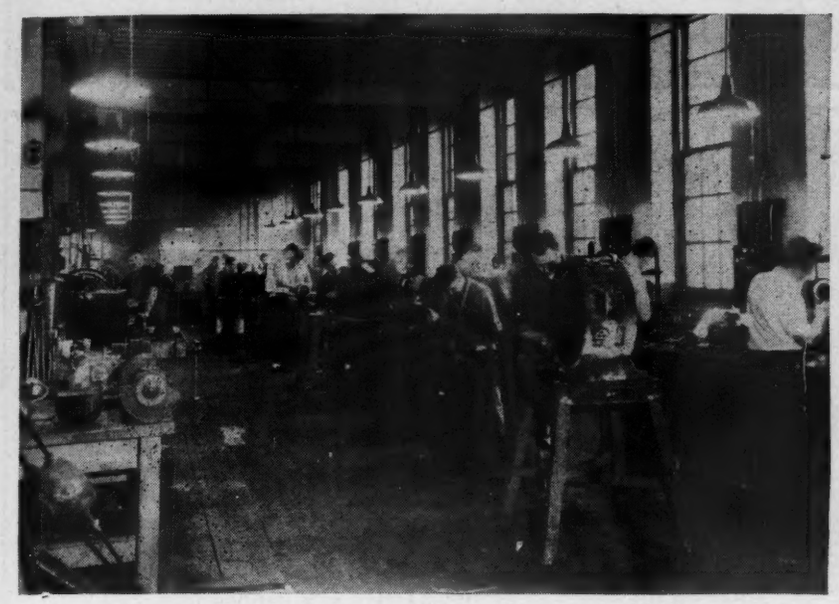
This school was organized in December 1944, under Public Laws 16 and 346 of the 78th U. S. Congress. It offers opportunities for the rehabilitation of veterans in acquiring a training in general skill under a planned program. It has the approval and cooperation of the Federal Committee on Apprenticeship, the Baltimore City Board of Education and the State Department of Education in Maryland.

Apprentices began first-year class instruction in October 1945. These students are now in the second-year class, and new apprentices are enrolled in the second first-year class. Students beginning the course in 1945 are scheduled to graduate in April, 1950, as skilled *electrical mechanics,* ace trouble shooters qualified to hold jobs as top grade journeyman electricians. It has previously taken apprentices about ten years to qualify as journeymen, under the old methods of training.

Brothers Guy and Charles Stark now own and operate the Stark Electric Company, organized early in this century by their father. They have long recognized the need for better training of electricians. They know that highly skilled craftsmen must be able to exercise independent judgment, understand the theory underlying the work they are called upon to do, and the properties of the materials used; and be capable in time of advancing to positions of leadership and responsibility.

The old method of training apprentices through practical experience and

for ELECTRICAL WORK



Part of main motor repair shop, Stark Electric Company, where electrician apprentices do actual repair work along with old-time employees, under general supervision of Training Supervisors. Each apprentice works in every department during course of training.

The Electrician Apprentice training program was conceived, organized and put into operation by Charles H. Stark (left) and his brother Guy Stark.

work only is considered outmoded—slow and inefficient. Formal training in vocational schools fails to hold the interest of the average student, probably because the training is too theoretical and not properly related to practical work. For these reasons it was decided that some new method of training was definitely needed. It should be fast, to meet the urgent need for better trained mechanics as industry converts to all-out peacetime production. It should be designed to attract and hold the apprentice's interest. Class instruction in theory is considered essential. Practical instruction is also necessary, a must. After careful consideration of these factors, and discussion with representatives of local vocational schools, the Veterans Administration, and the U. S. Department of Labor, it was decided that *related* training, with students working for wages while they learn, was the correct approach to this problem. It was on this premise that the Stark brothers developed and put into action the Electrician Apprentice Training program.

Electrician apprentices are now hired, trained, paid and kept employed by the Stark Electric Company under this new training program. Standards of Apprenticeship, which have been reviewed and registered with the Federal Committee on Apprenticeship have been adopted. These standards have as their broad purpose the establishment and maintenance of high standards of workmanship, and knowledge of the technical and theoretical aspects of the trade. It establishes policy and general conditions under which both the apprentice and the company operate, and forms a part of the Apprenticeship Agreement signed by both.

Under the electrician apprentice training program the apprentice must

TABLE I . . . Major Processes for Electrician Apprentices (Including Time Required for Each)

Assisting electrician in stripping and cleaning motors, generators and other electrical appliances	500 hours
Winding coils, armatures, starters, magnets, compensators and transformers, shape and form coils	1500 hours
Repairs to small motors, complete repairs, including test, experience in operating lathe and drill press	2000 hours
Repairs to large motors, complete repairs, including test	2000 hours
Industrial wiring, motors, starters, transformers, controllers and pole lines	1000 hours
Assisting electrician in trouble shooting and making necessary repairs	1000 hours
Total hours of experience	8000 hours

TABLE II . . . Wage Rate Scale for Electrician Apprentices

1st	1000 hours 48% of journeyman's rate
2nd	1000 hours 52% of journeyman's rate
3rd	1000 hours 56% of journeyman's rate
4th	1000 hours 60% of journeyman's rate
5th	1000 hours 64% of journeyman's rate
6th	1000 hours 68% of journeyman's rate
7th	1000 hours 72% of journeyman's rate
8th	1000 hours 76% of journeyman's rate

FIRST YEAR CURRICULUM

PART I

Safety switches and fuses
AB-I breakers and No-Fuse
Fusetrons, air and oil breakers
Fractional hp. motors
Review—quiz
A-c integral hp. motors
Types of squirrel cage motors
Wound rotor motors
Connections for dual voltage
Squirrel cage and wound rotor motors
Review—quiz

PART II

D-c integral hp. motors
A-c starters
Drum control and grid control
Review—quiz
Line and time starters
D-c starters
Various controls
Transformers
Review-quiz

PART III

Meters and instruments
Shop test meters
Battery and rectifiers
Review—quiz
A-c motor windings
Fluorescent lighting
Review
Final examination — Part I
Final examination — Part II
Final examination — Part III

SECOND YEAR CURRICULUM

FIRST HALF

Introduction — National Electrical Code and Code definitions
Wiring design and protection (Art. 200)
Branch circuits and calculation of load (Art. 210)
Feeders and services (Arts. 220, 230)
Practical problems of Code application and overcurrent protection (Art. 240)
Motor overcurrent protection and motor branch circuit protection
Ohm's law, formulas and problems

Review — quiz

Motors, controllers and grounding (Arts. 250, 430)
Use of triangle scale
Lightning arresters and Code problems (Art. 280)
Wiring methods and materials (Art. 300)

Review — quiz

Figuring resistance in series, parallel, series-parallel and parallel-series, with problems
Blueprint reading
Temperature limitations of insulated conductors and correction factors with problems
Conductor insulations and various types of conductors
Blueprint reading and drawing of floor plans for an industrial plant
Size of conductors for motors and various types of protection with problems, working from floor plans

Review—quiz—mid-year examination

SECOND HALF

Switches and auxiliary gutters (Art. 380)
Code problems from floor plans and Art 374
Appliances, control and protection (Art. 422)
Fixtures, lampholders, receptacles and rosettes, and Code problems (Art. 410)
Electric range installations in single and multiple family residences, hotels and industrial
Drawing floor plans of an apartment house with stores on the first floor
Motor load calculations and conductor sizes with problems
Transformer theory and connections, various bankings, etc.

Review — quiz

Determination of circuits, calculations of loads on watts per square foot basis, problems from floor plans
Working from blueprints of an industrial floor plan
Generators (Art. 445)
Transformer enclosures, transformers, vaults, installation, protection. Drawings by students of various hook-ups (Art. 450)
Practical problems of Code applications
Theatres and motion picture houses (Art. 520)
Emergency lighting (Art. 700)
Circuits and equipment operating at more than 600 volts (Art. 710)
High voltage systems with problems and floor plans
Articles 720 and 730
Review of Tables 1 to 34. Use of slide rule
Hazardous locations, Class 1, 2, 3 and 4 (Art. 500)
Fire pumps, paint spray booths, dry cleaning establishments and distilleries
Air conditioning fire hazards, motion picture booth ventilating, and infra-red drying booth ventilation

Review — final examination

put in at least 8000 hours (approximately four years) of reasonably continuous employment. He must also devote an additional minimum of 144 hours annually to *related* class instruction. During this period he receives such instructions and experience in all branches of the trade necessary to qualify him as an all-around electrician. He is assigned regular work in all departments of the company, and is taught theory in classes which relates to the work he is doing. The major processes in which he is given instruction and experience, and the number of hours required for each, are shown in Table I. Apprentices are not paid for time spent in class. Neither are hours spent in class included as part of the 8000 hours of work required by the program. Each new apprentice is subject to a 500 hour probationary period.

Working conditions of apprentices are the same as for regular company journeymen mechanics. They are paid a progressively increasing scale of wages by the company, based on a percentage rate of journeymen's wage rate, as shown in Table II. Where this rate totals less monthly wages than veterans qualify for under government regulations, the Veterans Administration makes up the difference. Apprentices are also offered an incentive in the form of a bonus, for perfect class attendance. This bonus is paid monthly, and is five percent of their wages for any one month. This incentive encourages not only perfect class attendance, but also full time work.

Each apprentice works under the immediate supervision of the foreman of the department to which he is assigned, and under the general supervision of a Training Supervisor. This Supervisor moves the apprentice from one department to another, sees to it that he is not held in any one department for a length of time greater than scheduled for that department, and acts as counsellor for the apprentice on all problems relating to his training.

One major factor in qualifying as an apprentice for this *related* training is that the applicant has a sincere desire to become an electrician. The company recognizes industry's responsibility to veterans, and gives preference to them in its selection of applicants for apprenticeship, but also accepts non-veterans who meet the

[Continued on page 141]

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Baking Speeded by Oven Replacement

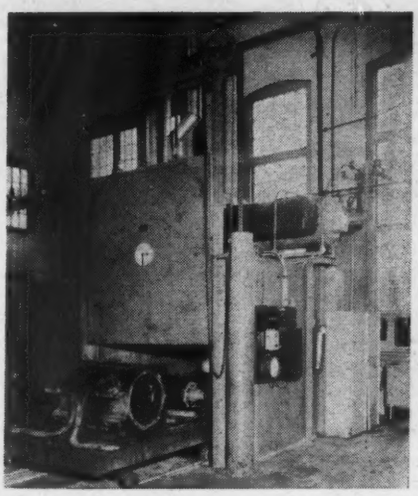
MAINTENANCE

The electrical shop of the Great Northern Railway, limited by floor space and baking facilities, solved their problem by installing a modern gas-fired Despatch oven measuring 6 by 10 feet in floor area and 7 feet in height. When asked for comments, the G.N. shop foreman stated that the new oven resulted in faster baking cycles, reduced baking costs, increased capacity, a better and more thorough baking and improved convenience. He speaks with the authority of two years experience with the equipment discussed.

Large diesel generators and diesel-electric motors up to three tons can now be baked in eight hours instead of 16, two 3-ton diesel-electric motors or diesel generator armatures can now be baked at one time and six 1-ton armatures for the diesel-electric motors are cured simultaneously. Generator armatures measure 36 inches in diameter and 38 inches in length. The huge loads are handled by a traveling crane and a rail-mounted oven dolly.

The oven is heated with a 500,000 B.t.u. air heater externally mounted on top of the oven to conserve floor space. The forced exhaust system complies with Underwriters' requirements and removes fumes rapidly from the oven as varnish solvents are evaporated. Engineers of the Great Northern shop, testing the oven at six different places with six thermocouples found that the heat variation throughout the baking enclosure was within 4 degrees F. Although the majority of work is done in the temperature range from 265 to 290 degrees F, the oven is capable of continuous operation at 500 degrees F, making the equipment capable of curing silicone products.

Baking capacity has been increased with the new oven until the shop now handles five times as many heavy traffic motors in the same floor space as it did before. Two batches or loads are handled in two shifts where only one load was possible before. The day crew takes out a finished batch in the morning and reloads, the night crew takes out a batch in the afternoon and reloads. The oven is set to shut off on completion of the baking cycle but fans are allowed to remain in operation to cool the load before the morning crew again takes over. Convection heat and automatic controls demand little or no attention from the operators and insure uniform temperatures throughout the baking period.



Oven installed in the electrical shop of the Great Northern Railway operates with 500,000 B.t.u., air heater externally mounted on top of oven to conserve floor area. Automatic controls regulate fans and heat so that operation is largely automatic. Counterweighted doors, rail mounted dolly and overhead crane facilitate loading.

Track and Trolley Proves Versatile

INDUSTRIAL

Under the trade names of several manufacturers, a variety of track-and-trolley power systems are available for supplying mobile power to electrical equipment used in commercial and industrial organizations. In the main plant of the Carrier Corporation, Syracuse, N. Y., the versatility of these systems is utilized in their electrical and carpentry shops as well as in their testing department. Enclosed electrical busways, protected against dust and mechanical injury by an encasing metal duct, place available current in a continuous, easily accessible location along benches, over plug-in boards and through areas in which small tools are constantly being employed. Trolleys, riding on wheels inside the metal housing of the duct and constantly energized through contact wheels held against copper feeding bars, move freely along the track. Cable connections to the moving trolleys permit power to be used for a variety of purposes.

In the accompanying photograph, two applications are pictured. The maintenance man is using current for testing purposes, the current passing along a portable cord affixed to a trolley riding along the overhead enclosed track. His work is lighted by a three-lamp fluorescent fixture which is supported by two trolleys, one of which is furnishing current to the fixture while the other one (insulated to prevent a

Track and trolley distribution system is utilized in electrical shop so that power and light may be located where needed by maintenance men. Rolling fluorescent fixture and plug-in socket to power small tools and testing devices are noted. Enclosed feeder bars, protected by encasing bus, delivers power to moving trolley through contact wheels and spring collectors.

For over fifty years Armored Cable has been providing a safe and low cost wiring system, and now with sizes 12 and 14 AWG you get still another improvement built into this outstanding cable—*bonding.*

A flat, tinned copper wire laid lengthwise of Hazard Armored Cable maintains intimate contact with every convolution of the steel armor and provides permanently low armor resistance. And under the provisions of the 1947 National Electrical Code, these two sizes are smaller and lighter in weight than ever before because of the new thinner insulation wall made of higher grade rubber.

Armored Cable provides the only available wiring system that incorporates a prefabricated cable with steel armor. Simple, quick installation is thus possible and long, trouble-free service assured. For full information on the new Hazard Bonded Armored Cable, ask your local Hazard representative or write The Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

HAZARD

insulated wires and cables for every electrical use

second contacting with the enclosed feeding bars) is employed for support. The track is supported by a messenger cable clamped at either end to angle iron braces and held by intermediately spaced hanger bars. The track is approximately 50 feet in length and is single phase 115 volt. When the maintenance man moves to a different location along the bench, the lighting fixture and tool connection are easily pushed along the track to furnish power and light in the new location. Since the track is equipped with several rolling lighting fixtures and plug-in sockets for small tools, the bench can be used simultaneously by six workers.

On a different floor the track and trolley arrangement is used to give mobility to a test panel. All required meters are mounted on a suspended meter board and moved along the track as called for at various plug-in positions. In that capacity, the track serves only as a rolling support instead of a combination support and electrical feed.

Pocket Size Contract Forms

OFFICE

Too frequently electrical contractors who do small jobs on verbal orders or agreements encounter embarrassing situations when seeking payment for their services. The customer may question the amount of the invoice or authorization for the extent of facilities installed. With no statement or quotation in writing, the contractor is at a distinct disadvantage and often must settle the account to the customers satisfaction but at a loss to himself.

A staunch proponent of the "put it in writing" theory, Frank Ecton, owner of Ecton Electric Company, Tulsa, Okla., has devised a pad of pocket size contract forms which his men carry with them. Should a customer want a small electrical job done, Ecton's representative estimates it in the field, notes scope of the work, starting and completion dates and cost (selling price) on the contract form. Both he (under Ecton's authorization) and the customer sign the contract on the spot and all is shipshape. When payment time rolls around, everything is in writing and there are no arguments or hard feelings.

The 9¼-in. by 5½-in. contract forms are printed in triplicate, one copy of which the customer retains. Noted in the printed agreement are: Scope of the Work; Contractor's Risk; Performance; Payment (terms and price); Liens (customer's right to demand proof of contractor's satisfactory settlement of material and labor cost obligations); Supervision; and the contractor's obligation to pay for all licenses, permits, insurance and taxes, damage to premises, etc (unless otherwise agreed), and compliance with all regulations applicable to the work.

Mr. Ecton finds the forms come in mighty handy when doing residential work, additions or alterations—much of which falls in the "small job" category.

Contract

AGREEMENT, made between ECTON ELECTRIC CO., of Tulsa, (herein called the Contractor), and.....
(herein called the customer).
WHEREIN IT IS MUTUALLY AGREED:

1. **Scope of the Work**—The Contractor agrees to furnish as an independent contractor:
   (a) All labor, tools and equipment, and supervision; and
   (b) All material and transportation, required to

   in accordance with any specifications or drawings attached hereto and made a part hereof.
2. **Contractor's Risk**—The Contractor agrees that the work shall be at the risk of the Contractor until completed and accepted by the Customer, except as to damage or injury directly caused by the Customer.
3. **Performance**—The Contractor shall commence performance hereon on..... 19..... and shall have substantially completed the same on or before..... 19.....
4. **Payment**—Except as may be otherwise provided in the specifications, the Customer shall pay to the Contractor for the performance of this contract, in its entirety, the sum of.....dollars ($.....) which shall be payable after acceptance of the work by the Customer.
5. **Liens**—The Customer shall have the right to require satisfactory proofs of payment, by the Contractor, of all labor and material furnished under this contract, before acceptance of the work, but no action or nonaction of the Customer in requiring such proofs shall relieve the Contractor of the duty of causing any and all liens arising out of the contract to be fully satisfied and discharged.
6. **Supervision**—The Contractor shall provide a competent supervisor who shall be the duly authorized representative of the Contractor in carrying on and completing the work in accordance with the contract.
7. Except as may be otherwise provided in the specifications, the Contractor shall:
   A. Obtain and pay for any and all licenses and permits necessary in carrying out the work;
   B. Maintain such insurance as may be required under Workmen's Compensation Acts, Employers' Liability Acts, or other applicable laws, for the protection of contractor's (or any sub-contractor's) employees, or the public, against injury or damage or both; and,
   C. Shall promptly advise the authorized representatives of the Contractor of all damage to property, or injuries incurred by persons other than employees of the Contractor (or of any sub-contractor) relating, either in any manner, directly or indirectly, with the work.
   D. Shall pay any and all Social Security, Unemployment Compensation, excise, sales, use, or other taxes applicable to the scope of the work.
8. The Contractor shall obey and comply with all laws, ordinances, regulations, and other rules, federal, state and municipal, applicable to the work.

IN WITNESS HEREOF, the parties have caused this agreement to be executed in their respective names by an individual, member, or officer thereunto duly authorized this..... day of.....19.....

ECTON ELECTRIC CO.
Contractor

By _____

_____
Customer

By _____

Title _____

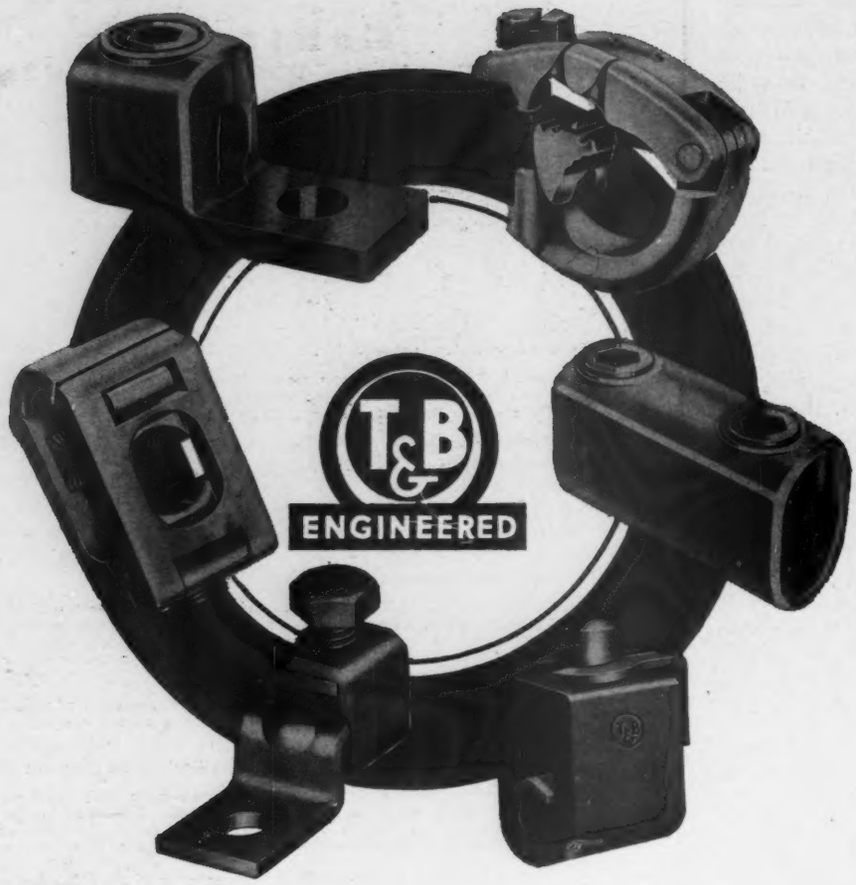
Pocket sized contract form used by Ecton Electric Company for small electric jobs.

Central Intercom Control for Trucks

INDUSTRIAL

The Spicer Manufacturing Corporation of Toledo, Ohio, makers of universal joints, transmissions, clutches and other automobile parts, is again supplying the civilian needs of the automotive industry after extensive war work.

Like most large manufacturers, Spicer uses a great many power-driven trucks to convey material from one



NO Compromise with Quality

You electrical contractors who use T&B Lock-Tite Pressure Connectors have this assurance:

Bearing the T&B name, these high quality wire and cable fittings are today, and always have been, free from any trace of substitute material.

Even during the stress of war production when manufacturers' quality was sometimes slighted, T&B quality standards held true to form.

Play safe. Use our Underwriters Laboratories' Approved Lock-Tite Pressure Connectors on every job where you want to enhance your reputation for dependable electrical installations.

For your convenience and protection, supplies of our fittings are sold only through T&B Electrical Wholesalers, one of whom is near at hand, and ready to take care of you. Ask him for T&B Lock-Tite Bulletin 64.

The Thomas & Betts Co.
INCORPORATED
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1898
ELIZABETH 1, NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal

part of the plant to another, or from one department to another. This created a problem: how to know where any truck was at a given time so that a department which needed a truck could be served on very short notice.

The two sections of the plant cover several acres and trucks constantly were being lost in the shuffle. Much time was wasted by departments waiting for material and by departments which had material to be moved out.

In simple terms, the problem reduced itself to the need of quick communication between the operators of roving trucks and a central point from which the trucks could be controlled and their operations coordinated. An "Internal Trucking Department" was set up and the installation of two separate central control inter-communications systems, one for each section of the plant, provided an amazingly simple yet completely satisfactory solution. These systems were planned and furnished by Executone, Inc., New York City and installed by H. D. Hughes, of Cleveland.

The two control stations are placed on a large desk in an office designated as the truck dispatcher's office. Seventeen substations are located at strategic points which give complete coverage of the huge plant. Nine substations in one section of the plant are connected to one control station and eight substations in the other section of the plant are connected to the other control station. Each substation is placed on a shelf and protected by a special housing as shown in the illustration.

A control chart, called the dispatch board, is placed on the large desk in the dispatcher's office. An outline of both sections of the plant is painted on the board and holes, drilled in the board, show the location of each department and the location of each of the 17 strategically located substations. Through the use of pegs numbered to represent different trucks, the dispatchers, by placing these pegs in the holes representing different departments, know at all times where any truck may be. The dispatchers get the information regarding the location of the trucks through the inter-communication system, as each truck operator at the completion of a job calls the dispatcher through one of the strategically located substations and reports that he is ready for another assignment.

Two men are required to man the dispatch office because of the heavy truck traffic and the many calls for trucks which are being received all the time.

At the end of the day, all of the trucks go to one point, known as the truck pool. In the morning, each driver of a truck takes his truck to the substation to which he is assigned. Now, suppose that Department 17 needs a truck. The operator at the dispatch board uses his Master station to call the truck which is nearest to Department 17. The peg, bearing the number of this truck operator, is then placed at Department 17. As soon as the driver completes his work, he goes to the nearest intercom substation and reports to the dispatcher's office that he is ready for another assignment.

The Spicer Manufacturing Corporation believes in the old saying, "You can't make money driving an empty wagon." They have practically eliminated "empty" driving.

FIG. 1 — Dispatchers keep control record of each intra-plant truck by talking to all departments in the Spicer Manufacturing Corporation, Toledo, Ohio plant through an Executone intercom system.

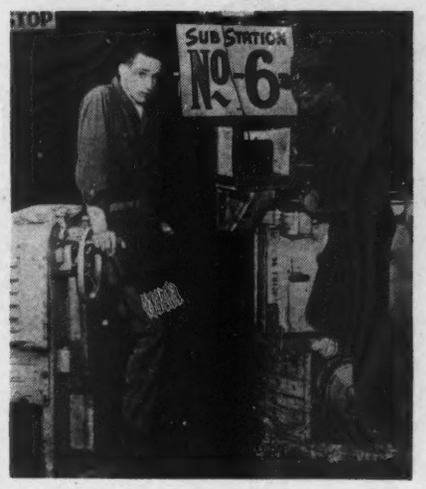


FIG. 2—Operators of power-driven trucks report to the dispatchers' office through Executone intercom system substations located in the plant.

Cantilever Truck For Maintenance

MAINTENANCE

Several practical features are incorporated in the maintenance trucks used in the city of Syracuse, N.Y., for the replacement of street lighting lamps and the routine cleaning of fixtures.

The workman on the scaffold controls the angle at which the platform is to be projected and manually moves his cantilever platform in or out from the central tower by means of a rapidly-adjusting hand wheel. The driver of the truck determines the height of the main tower by means of a clutch that connects the lifting mechanism with the power drive.

In operation, the movements of both the central tower and the revolving and projecting working platform are rapid and smooth. The workman on top is assured of a firm, large, safe working area where he can store replacement parts and move about freely without danger of injury through falling from an unguarded elevated area. The cantilever action is of sufficient range to extend over parked cars along the curb line and it becomes unnecessary to pull into the curb. Maintenance is quick, thorough, efficient. Spare parts and maintenance tools are carried in convenient, well-stocked lockers mounted on the body of the truck.

Maintenance trucks used by City of Syracuse, N. Y., for street light replacement and repair are fitted with telescopic central towers and cantilever working platforms. Extending over 20 feet upwards and 10 feet outwards, the maintenance man can work without requiring the removal of parked cars. Sturdy, protected platform offers safety and storage area.

IT'S WHAT'S
inside
THAT COUNTS!
BULLETIN 504 3 POLE SIZE 2 TYPE FORM
MAGNETIC A.C. MOTOR STARTER
CAT. NO.
FEDERAL ELECTRIC PRODUCTS CO. INC. NEWARK, NEW JERSEY MADE IN U.S.A.

HIDDEN BEHIND THE FACE

of your watch are over 150 precision parts—the "works" that make a watch a useful and dependable mechanism. In FEDERAL NOARK electric products, as in the construction of a fine time-piece, *precision* is a built-in characteristic . . . precision that makes for dependable performance under the most gruelling of operating conditions.

HERE'S THE "WORKS" OF A FEDERAL NOARK MAGNETIC MOTOR STARTER

• Double Break Silver Contacts • Accessible Stationary Contacts • Single Screw Movable Contacts • Heavy Arc Barriers for Strength • Ball Bearings & Movable Yoke • Non-Carbonizing Asbestos Base • Vertical Ball Bearing Action • Quick-Change Coils • Overload Relays — Hand & Automatic Reset • Front Mounted Accessible Heaters

Federal Electric Products Company, Executive Offices: 50 Paris Street, Newark 5, N. J. • Plants: Hartford, Conn. • Newark, N. J. • St. Louis, Mo.

Federal NOARK
INDUSTRIAL CONTROLS

FEDERAL ELECTRIC PRODUCTS COMPANY, MANUFACTURERS OF A COMPLETE LINE OF ELECTRICAL PRODUCTS INCLUDING: MOTOR CONTROLS, SAFETY SWITCHES, CIRCUIT BREAKERS, SERVICE EQUIPMENT, PANELBOARDS

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

Equipment News

Stocklight

Stocklite

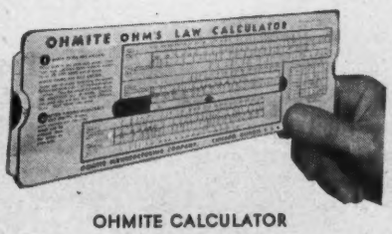
Bins in narrow stock room aisles are illuminated efficiently by Stocklites, a designed light with 8 reflecting surfaces. Curved V-shape end reflectors eliminate glare in aisles by shielding light source from field of vision. Porcelain enamel coating makes light easy to clean. Installation is in conjunction with a separable hood which makes it possible to service unit with minimum of labor. Goodrich Elec. Co., 4600 Belle Plaine Ave., Chicago 41, Ill.

Capacitors

CAPACITRON BALLASTRON

Ballastrons are specially designed capacitors which provide high power factor correction of low power factor ballasts. They are for use with either new or existing fluorescent fixtures. They mount in the fixture channel near the ballast and connect directly across the a-c line. They are designed to fit all standard fixtures. Ballastron has been approved by Underwriters' Laboratories. The Capacitron Co., 849 N. Kedzie Ave., Chicago 51, Ill.

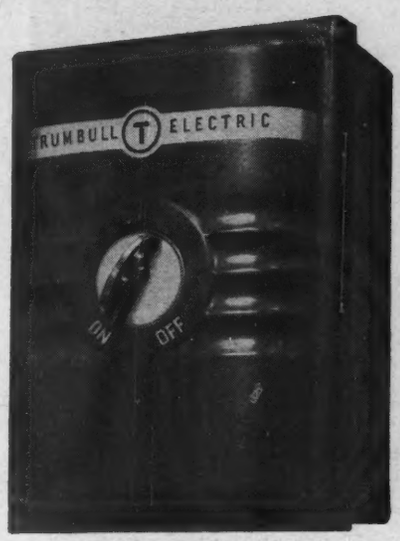
Ohm's Law Calculator



OHMITE CALCULATOR

A pocket-size calculator solves resistance calculations. With one setting it is possible to read ohms, volts, amperes and watts for any problem involving Ohm's Law. It will also solve parallel resistance and series capacitance problems, multiply, divide and find squares and square roots. The range covers all currents, resistances, voltages and wattages commonly encountered in industrial and radio work. Ohmite Mfg. Co., 4937 Flournoy St., Chicago, Ill.

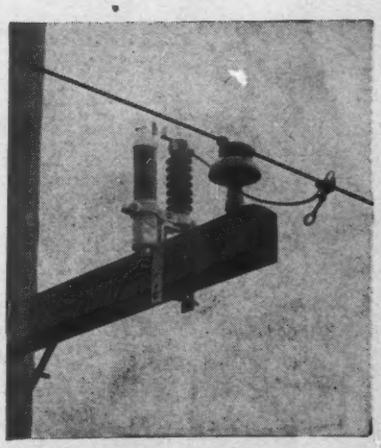
Safety Switch



TRUMBULL SAFETY SWITCH

Type D enclosed safety switches are rated at 30 amperes and are contained in boxes measuring 4½ by 3¼ by 6⅛-inches. A triple duty spring takes up the loose tolerance of the front-mounted handle, provides a flexible connection to movable contacts and acts as a seal between handle and cover. Locking the pivoting lever in the OFF position prevents tampering by unauthorized personnel. Entire switch mechanism may be removed by loosening a single screw. Trumbull Electric Mfg. Co., Plainville, Conn.

Rural Lightning Arrester


G. E. ARRESTER

A heavy-duty expulsion-type arrester for lightning protection on rural lines, named the Hi-Stroke rural arrester, is available in 6 and 9 kv. ratings. The internal gap is located in an interrupting chamber containing gas-evolving material in the form of cellulose fiber spheres. Automatic feed replenishes the supply of spheres after each discharge. An insulator, separate from the arrester, prevents leakage current and assures that voltage is applied to the arrester element only during actual discharge. A variety of hangers satisfies all mounting problems, either alone or for combination mounting with enclosed or open type fuse cutouts. General Electric Co., Schenectady 5, N. Y.

when cable runs must "run the gauntlet"

a DELTABESTON* cable will give extra assurance of uninterrupted power

Conditions that shorten the life and threaten the performance of regular types of cable are often unavoidable around the power plant. But that's just where the chances of a cable failure *can't* be allowed to rise.

How can you maintain the same safety factor under *extra severe* conditions that you expect from standard power cable under normal conditions? The answer may lie in a DELTABESTON Cable of special construction, like the one shown here. It's one of many developed to "run the gauntlet" of unusual conditions for central stations and power plants.

Probably, this particular cable is *not* the one you'll need to meet your combination of conditions. In most cases, one of the regular Deltabeston types will do so. But remember that specialists in heat-resisting cable are always "on call" to select or even develop a Deltabeston construction that will maintain an adequate safety-factor for years to come.

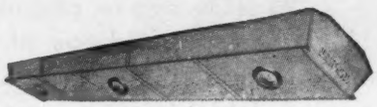
For further information, write Section Y55-218, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut. Deltabeston Wires and Cables are distributed by G-E Merchandise Distributors.

* *Trade-mark Reg. U.S. Pat. Off.*

GENERAL ELECTRIC

Right Spot Units

RSU, Right Spot Units, is a new type of luminaire that combines fluorescent lighting with incandescent flood lamps. A dual-purpose, space utilizing light for general illumination and merchandise display flood and spotlighting. Recessed and surface mounted models are available. Luminaires range from 40 to 61 inches in length, with 24 inch compensating, auxiliary unit to supplement continuous lines of light where space is limited. Floodlights and spotlights can be centered on 4, 5, 6 or 7½ foot centers or multiples thereof, depending on length of unit. They are for use with 40 and 100 watt fluorescent lamps. Also furnished with eggcrate louver. All-Bright Electric Products Company, 3917-25 N. Kedzie Avenue, Chicago 18, Ill.



ALL-BRIGHT UNIT

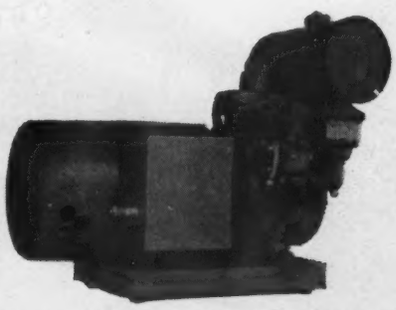
Combustion Control

Flame failure or dangerously low boiler water levels are corrected or attention of supervisor is attracted by Fireye Combustion Control F18TS, designed to protect commercial or industrial oil burning equipment. An electric eye, focussed on the flame, instantly cuts the oil supply or sounds an alarm when the flame fails. With auxiliary fitting 65BF1, a probe constantly measures water levels and insufficient water motivates the equipment that cuts fuel supplies and sounds a warning. Bulletins 102-C and 104-C give specifications and applications. Combustion Control Corp., 77 Broadway, Cambridge, Mass.

COMBUSTION FIREYE

Mobile Power Plant

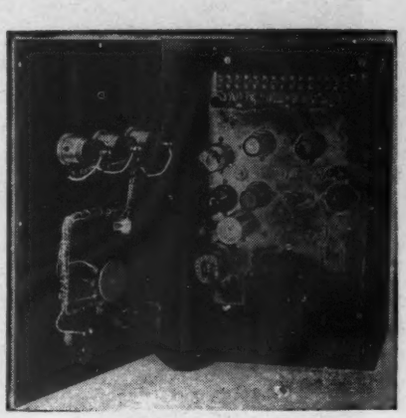
Electric tools, floodlights, transmitters and receivers can be operated in locations not served by utility lines by using power from a Katolight plant. Model 23HAB4 has a capacity of 500 watts, is compact, economical and easy to operate. The unit, with push button mounted on generator with cutout, is equipped with d-c ammeter, charge control resistor and battery cables. The generator is 110 volt, 60 cycle, 1800 rpm. Approximately 25 amps. at 6 volts, d-c is available for battery charging. Generator is furnished with radio interference suppression parts. It is powered with a 1 hp. single cylinder aircooled engine. Shipping weight is 175 lbs. Kato Engineering Co., Mankato, Minn.



KATOLIGHT

Feed Regulator

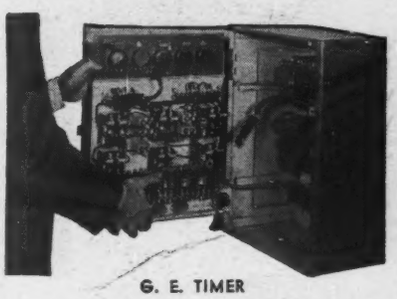
Milling increases of 35 percent are possible when using electronic regulation for pulverizing feeds, states the manufacturers of Mosher controls. Amplified signal coordinates feeds to maximum grinder loads and eliminates adjustment of critical relays. Power line fluctuations have no effect on these controls. Some of the advantages claimed are less manual supervision and more uniform pulverizer outputs for cutters, hammer mills and similar equipment. Mosher Electronic Controls, 130 West 42nd St., New York 18, N. Y.



MOSHER CONTROL

Sequence Weld Timers

Sequence and sequence-weld timers have been redesigned for resistance welders. They combine and coordinate the mechanical operation of an air or fluid-operated spot or projection welder with the flow of welding current as determined by a synchronous-precision weld timer. All electrical connections between front and rear panels are of the plug type so that front or timing control section can be readily removed and placed in another machine. Hinged front panel, redesigned wiring system and standard industrial-type relays simplify routine inspection. Initiating circuit, normally 115 volts, can be changed to 24 volts and two-stage foot-switch can be added. All 60 cycle panels are suitable for operation on 208, 230, 460 or 575 volts, 50 or 60 cycles. General Electric Co., Apparatus Department, Schenectady 5, N. Y.



G. E. TIMER

Signal Timing

A signal timer that can be plugged at either end of an appliance cord glows dimly to show normal flow of current and glows brightly when current reaches the appliance's watt rating. Outer casing of plastic, metal caps and bushed fittings protect wires entering both ends. Sizes: 250, 300, 400, 500, 750, 850, 1,000 and 1,250 watts (standard) and other special sizes to 2,500 watts. Operates a-c or d-c, 125 and 250 volts. Pilotron Company of America, 3774 Surf Ave., Brooklyn 24, N. Y.

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

This system of Buckeye conduit, installed in a large department store a generation ago, still provides dependable wiring protection to owners and tenants.

RACEWAYS to lasting safety

WHEN you're planning wiring systems for the buildings of tomorrow, safety is naturally a first consideration. Not only safety, but *permanent* safety!

The electrical industry has long since agreed--and incorporated it in the national code--that the one safest system for the lasting protection of electrical wiring is that employing heavy-wall steel conduit. This is the only system approved for use in hazardous locations and occupancies, as being dependably moisture, vapor, dust, and explosion proof.

So for positive protection, install permanent raceways of full-weight, rigid steel conduit--"Buckeye" conduit. Wiring is easily changed to meet changing day-to-day needs, yet the conduit remains in place, as raceways to lasting safety.

Youngstown "Buckeye," the world's most widely used standard-threaded, full-weight, rigid steel conduit, is sold by leading distributors in all markets.

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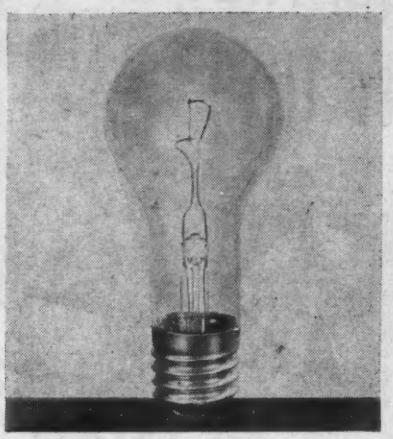
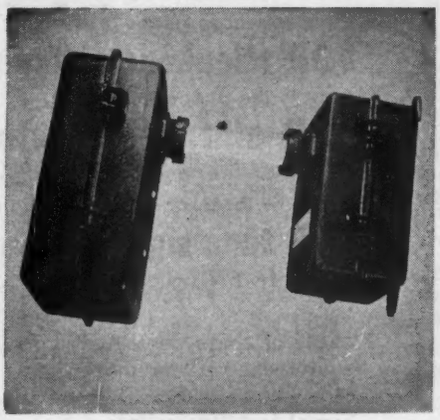
Street Lighting



SYLVANIA LAMP

Small size bulb gives increased light and can be used in existing highway fixture. The new PS-25 has a 2500 lumen, 6.6 amp. rating and can be obtained in both regular and group replacement types. The regular lamp has a laboratory life of 2000 hours with an average voltage of 21.7 while the group replacement lamp tests for 3000 hours and 23 average volts. Both lamps have characteristics common to the larger PS-35 lamp. Sylvania Electric Products, Inc., Salem, Mass.

Smoke Indicator



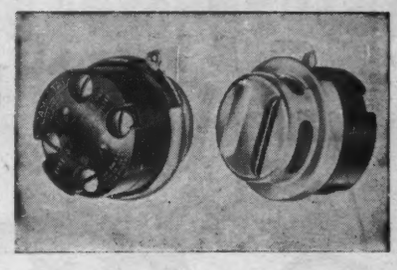
PHOTOSWITCH INDICATOR

Photoelectric smoke indicator A20C, located in the flue or breaching of a heating or power plant, measures the density of smoke in the gaseous products of combustion and motivates an audible or visible signal when the density passes the pre-set values prescribed by municipal smoke ordinances. The light source and photoelectric control are mounted on opposite sides of the flue, a sensitivity adjustment permitting the selection of desired values. Additional equipment activates continuous recording apparatus and indicates exact times of alarms. Photoswitch, Inc., 21 Chestnut St., Cambridge, Mass.

Induction Motor

A new all steel squirrel cage induction motor has been announced. Known as the "Life-Line" motor, it is available in drip-proof, splashproof and fan cooled construction. Some of the features are: a frame rolled from steel plate; feet and end brackets of heavy pressed steel; all welded construction; self-sealed, pre-lubricated ball bearings that provide lubrication for five years or longer without repacking; rounded corners at top and bottom of slot cells that eliminate creasing cell insulation; special synthetic resin covered wire for coils; It is available in sizes from ½ to 20 hp.; in voltages of 208, 200, 440, and 550; in two and three phase; in frequencies and speed of 60 cycle. Westinghouse Electric Corp., 306 Fourth Avenue, Pittsburgh 30, Pa.

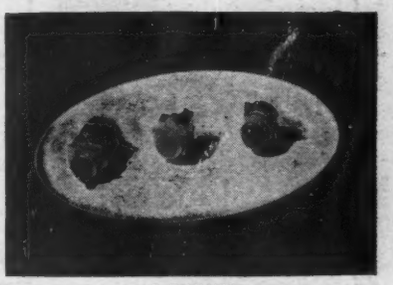
Thermostat



CAM-STAT THERMOSTAT

A compact (roughly 1½ inches in diameter and 1¼ inches deep) thermostat for general application at 120-240 volts a-c has a current carrying capacity of 1500 volt-amps. (no condenser required), low differentials (2 degrees F.), wide selection of temperature ranges (minus 50 to plus 350 degrees F.), resistance to vibrations and positive switching action. Type A Cam-Stat is recommended for operation of water heaters, furnace fans, limit controls and room thermostats. Construction is of aluminum and plastic. Cam-Stat, Inc., 2037 South La Cienega, Los Angeles, Cal.

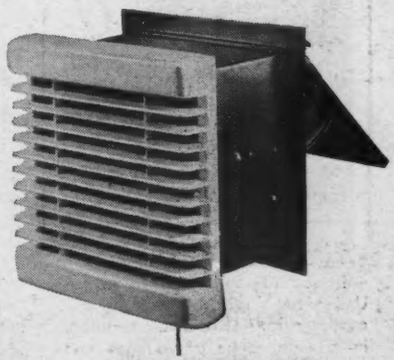
Oiltight Pushbutton Units



G-E UNITS

A new line of oiltight pushbutton units, selector switches, and indicating lights designed for machine tool and automotive industries has been announced by Control Div. of G-E. The momentary contact pushbutton units are available in several forms. The single pole unit provides a normally open and a normally closed circuit. The three point unit provides two normally open circuits with common connection. Double pole units are available with either normally open or normally closed circuits. The selector switch unit is available in single pole double throw, or double pole single throw forms. Contacts are cam-operated. They are available for use on 110-125 or 250 volts, a-c or d-c and may be used on higher voltages with separately mounted resistors. General Electric Company, Schenectady 5, N. Y.

Ventilator

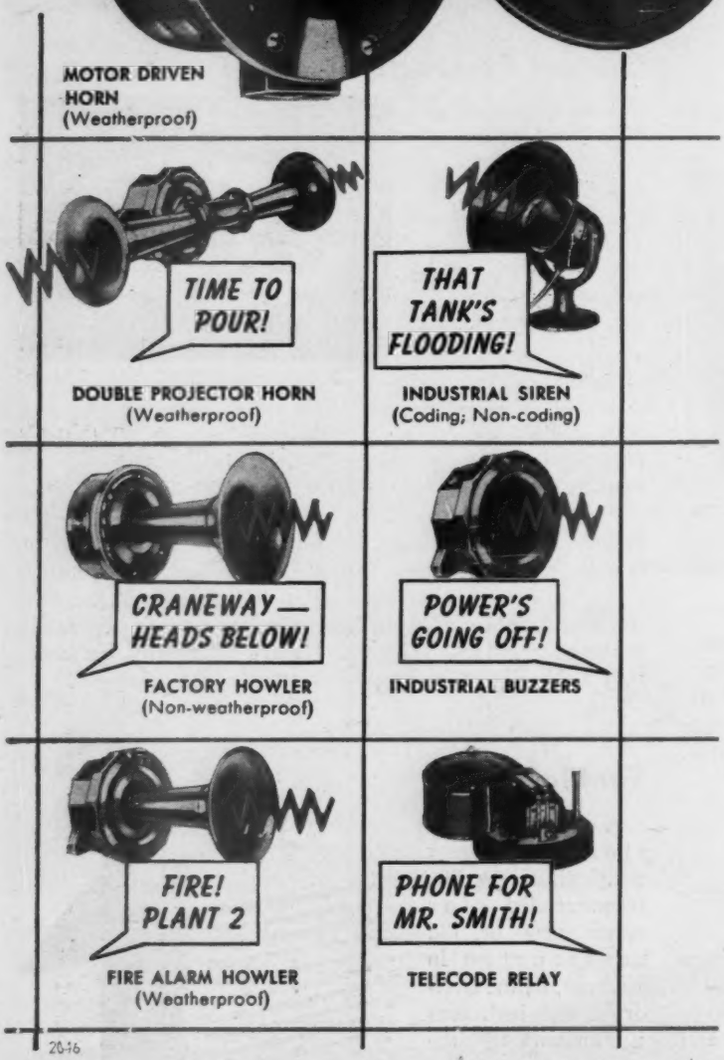


AMERICAN VENTILATOR

A streamlined, sturdy ventilator with plastic grille, recommended for either new or old construction in kitchens, baths, laundries and bedrooms is known as the aeropel home ventilator. The three-bladed ventura fan is driven by an enclosed 115 volt, 60/50 cycle, single phase motor. Motor automatically starts when insulated weather door is opened. Capacity is 400 cfm. American Blower Corp., 8469 East Jefferson St., Detroit, Mich.

They Warn, They Page, They SAW Through ANY Din!

The unique, wide-range, high-frequency note of a Benjamin Signal (red sonograph curve above) makes itself heard through any industrial racket, monotonous or varied. Typical industrial noises are shown as black curves in diagram above.



FOR executive paging—To locate quickly the men whose duties take them through the plant.

FOR telephone signaling—where noise drowns the phone bell.

FOR alarms and warnings—calling guards or firemen to the right place, for warnings of overflow, breakage and interruptions.

FOR time signaling—process-flow notices, hours-of-work signals.

One of these days, one slight accident to men or equipment will far more than overbalance the cost of a Benjamin Signal installation. Too, a Benjamin Signal installation cuts out the perpetual confusion, delay and annoyance of hunting for wandering, wanted personnel...a real contribution to operating efficiency.

You need such a system, you need *THIS* one, because the attention-getting voice of a Benjamin Signal can be depended upon to saw through any industrial noise; to produce a sound volume that is audible over a large area; and to be ruggedly constructed and especially designed for industrial and commercial service.

Draw on 30 Years' Signal Experience!

Benjamin horns and buzzers have been used for over 30 years in calling, warning, and paging signal systems in thousands of industrial plants. Pitch and volume are right for every use, relays and parts are made to the very highest standards. Let Benjamin Engineers help you obtain greater efficiency, better protection, a reduction in the accident rate, and savings in time and labor, with Benjamin Signals. Write for data!... Benjamin Electric Mfg. Co., Dep't H, Des Plaines (Chicago Suburb), Illinois.

Benjamin signals are listed by the Underwriters' Laboratories. They are available for A.C. or D.C. operation, in a wide range of voltages and cycles. Many can be had with choice of Double or Single Projectors.

A feature of Benjamin Vibrating Horns and Buzzers is the ease of servicing due to their unique construction which permits removal of the entire operating mechanism without touching the wiring.

Benjamin Telecode Relays are specially designed for connecting horns to telephone ringer circuits to replace bells in noisy locations where telephone bells can not be heard. For complete data, write for Bulletins.

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Dry Type and Askarel Insulated Transformers—Part I

First of a series of two articles on why, when and where to apply dry and askarel insulated transformers in industrial plants and commercial buildings.

By M. L. Hurni
Distribution Transformer Section
General Electric Company

ABOUT 15 years ago the first non-inflammable transformers were developed and marketed. These transformers were of the non-inflammable liquid type in which a fireproof liquid was used as a cooling and insulating medium instead of the then universally employed mineral oil. This kind of transformer promised important advantages, particularly in industry. Data was obtained with the load center power system engineering principles that indicated important savings in installation cost and the more efficient use of electric power without the hazards contingent upon the use of oil as a cooling and insulating medium.

The fulfillment of this promise is evident in the record of the past 15 years which indicates continually increasing use of such transformers in industrial and business establishments even though these transformers continue to be higher in price than oil filled units. Today two types of transformers are used for this type of installation, the askarel insulated transformer and the Class B insulated dry type transformer.

It is indicated above that these transformers have proved themselves to be money savers and that they are used for this reason. They save money because:

1. In general, the National Electrical Code permits the installation of such transformers anywhere without any extraordinary and expensive precautions against possible fire and explosion.

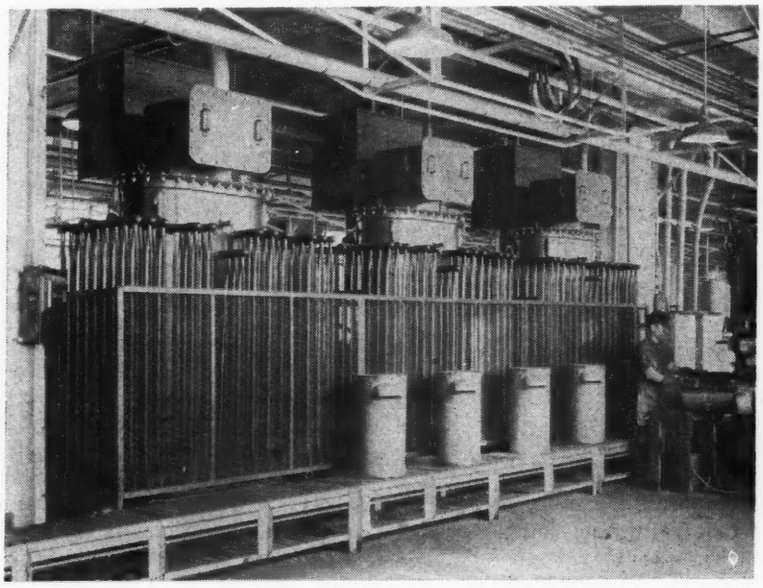
2. By taking advantage of these permissive features of the Code and installing the transformers as close to the load as possible, important savings in installation and operating cost are obtained.

By reasons of the National Electrical Code requirements or the dictates of cautious, foresighted engineering, oil-filled transformers cannot usually be installed at the load without prohibitively expensive fire- and explosion-proof vaults. In most cases the cost of such vaults will more than wipe out the savings to be made by installation at the load. Experience has indicated that the most economical arrangement of oil-filled transformers is to install them out of doors which in many cases means long runs of heavy secondary copper.

The advantages gained by installing transformers as close to the load as possible are:

1. Reduced installation cost.
2. Improved voltage regulation.
3. Reduction of losses, hence reduction in costs of power.

These benefits are obtained by virtue of the fact that electric power can be



Askarel insulated transformers located at the load. This bank of transformers supplies a bank of projection welders, one of which can be seen in the foreground. The supply voltage is 13,800—the utilization voltage is 575.

delivered close to the load at relatively high voltage since the askarel insulated or dry type transformers can be located there economically. As a result only short low-voltage runs to utilization equipment are required.

As an example of the effect of higher voltage distribution into the load area on the cost of the installation, consider a case where it is desired to transmit 1000 kva. of three-phase power to certain utilization equipment operating at 480 volts. In this case two alternatives present themselves:

1. Locate oil-filled transformers out of doors and transmit the power the entire distance at 480 volts.

2. Locate either an askarel insulated or a dry type transformer indoors close to the load and transmit the power to the substation at higher voltage.

In this latter case the transformer will be somewhat more expensive but the cost of the cable and its installation will be substantially less.

For purposes of comparison consider the following table that gives the approximate cost per foot of installed interlocked armored cable to transmit 1000 kva. of three-phase power at 4160 or 480 volts:

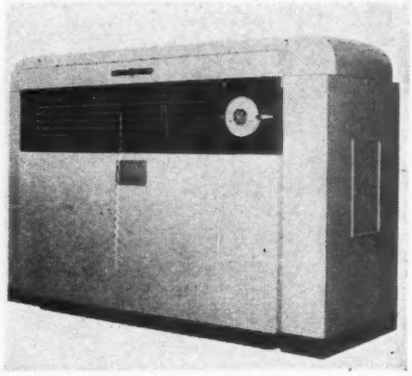
Voltage	4160	480
Size Cable	#00	250 MCM
No. of cables/phase..	1	6
Approx. cost per foot.	$0.95	$7.65

If that portion of this installation which can be alternatively designed for 4160- or 480-volt operation requires a cable run of only 75 to 100 feet it will more than pay for the additional cost of the askarel insulated or dry type transformer.

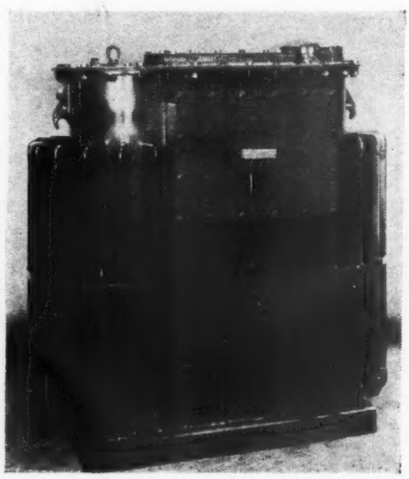
Savings can also be made quite frequently in the cost of low-voltage feeder breakers. A logical pursuit of the idea of bringing primary voltage as close to the load as possible dictates, in many cases, that more than one transformer of smaller size than the total load be employed, each transformer serving a portion of the load area. By employing several transformers the magnitude of the short circuit current available at any low voltage feeder is greatly reduced from that available if the total load is supplied from a single bus. Therefore air circuit breakers of lower interrupting rating and lower cost can be used in almost every case.

In addition to the savings in installation cost that can be obtained on any reasonable size installations, other operating benefits that pay dividends year by year are also possible by installing the transformers as close to the load as possible.

The maintenance of the right voltage



Typical Class-B-insulated dry type transformer. Ventilation is obtained by the circulation of air entering screened openings at the bottom where the casing overhangs the base, and leaving through the large louvres near the top.



Typical askarel immersed transformer, illustrating the sealed tank construction. Relief diaphragm on the cover.

has a decided effect on the performance of plant equipment. If the voltage is 10 percent low, heating devices such as soldering irons, heating ovens etc. produce only 80 percent as much heat as if normal voltage were applied. Likewise, motor torque drops as the square of the voltage drops.

With a properly designed installation employing transformers located close to the load, it is not difficult to hold the voltage drop from the transformer to the end of a low voltage feeder to approximately 2 or 3 percent maximum. In contrast in systems with long low voltage feeders, it is not uncommon to have a voltage drop of 10 to 20 percent along the length of the feeder. With such systems it is not an unusual practice to maintain the voltage considerably above normal at the bus in order to maintain enough voltage at the end of long feeders to operate utilization devices. This may result in more frequent burn outs of heating devices, lamps, motors, contractor coils etc. located in areas close to the main bus.

If it is recalled that losses vary as the square of the current and directly as the resistance, it is easy to see that the practice of bringing primary voltage as close to the load as possible results in reduced losses and greater efficiency in distributing power. Considering the example previously cited where six 250 MCM cables per phase were used to transmit 1000 kva. at 480 volts and one No. 00 cable per phase at 4160 volts, the losses at 480 volts will be roughly seven times as great as at 4160 volts.

Studies on many specific jobs have demonstrated the possibilities of obtaining better and more economical electrical distribution systems by using askarel insulated or dry type transformers installed either close to the load or in the center of a small load area. The most extensive use of such transformers today is in load center unit substations.

In the askarel insulated transformer, the core and coil structure is quite similar to that used in oil filled transformers. Insulations consist of such materials as paper, pressboard, cotton, electrical grades of shellac, etc. This structure is immersed in a synthetic liquid of proper insulating and heat absorbing characteristics that will not burn or support combustion or give off explosive or inflammable gases. This liquid is known as askarel. To ignite such a transformer can be likened to igniting a stick of wood in water.

The core and coil structure and the surrounding non-inflammable liquid is contained in a sealed steel vessel capable of withstanding normal operating pressures. Such transformers are usually identified by the trade names given the non-inflammable liquid by the various transformer manufacturers. Typical names are Pyranol, Inerteen, Chlorextol etc.

In the dry type transformer inorganic insulations are employed in the core and coil structure insofar as possible. The materials usually employed are glass cloth and tape, mica, porcelain and asbestos. The binding material, used to provide additional insulation strength and to unite the coils into a common mass, is an organic varnish with relatively high ignition temperature. The dry type transformer is usually enclosed in a lightweight, ventilated sheet metal case, intended principally to isolate the windings and provide physical protection.

A comparison of the methods employed to reduce or eliminate the hazards of fire is easily made.

1. In the askarel insulated transformer, commonly used insulating materials that of themselves will burn are used, but they are immersed in and saturated with a liquid that precludes the possibility of fire.

2. In the Class B insulated dry type transformer an effort is made to use materials that are inherently non-inflammable or have relatively high ignition temperature.

Dry type transformers using inflammable insulating materials have been built since transformers were first manufactured. In fact the first transformer built was of this construction. Such transformers are naturally inflammable and, except in the case of the smaller sizes and lowest voltages, must be installed in a separate room of fire resistant construction. The dry type transformers described in this article are those in which inorganic insulating materials are used, bonded together with a high temperature organic binder. These transformers are known as Class B insulated. It is only the Class B insulated type that may be installed without precautionary measures according to the National Electrical Code. The wording of the Code in reference to the indoor installation of dry type transformers, Paragraph 4521, is as follows:

"Dry Type Transformers Installed Indoors.

"Transformers rated 100 kva. or less shall have a separation of at least 12 inches from combustible material unless separated therefrom by a fire-resistant heat insulating barrier, or unless of a rating not exceeding 600 volts and completely enclosed except for ventilating openings.

"Transformers of more than 100 kva. rating shall be installed in a transformer room of fire-resistant construction unless they are constructed of Class B insulation as defined in American Standard for Transformers C-57.1 and are separated from combustible material not less than 6 feet horizontally and 12 feet vertically or are separated therefrom by a fire resisting, heat insulating barrier.

"Transformers rated more than 15,000 volts shall be installed in a vault."

Both kinds of dry type transformers are available. Care should be exercised that Class B insulated transformers are obtained if the full economies outlined earlier in this article are to be obtained.

The wording of the National Electrical Code relative to askarel insulated transformers, Paragraph 4522, is as follows:

"Askarel Insulated Transformers Installed Indoors."

"Askarel insulated transformers rated in excess of 25 kva. shall be furnished with a pressure relief vent. If installed in a poorly ventilated place they shall be furnished with a means of absorbing any gases generated by arcing inside the case, or the pressure relief vent shall be connected to a chimney or flue which will carry such gases outside the building. Askarel insulated transformers rated more than 15,000 volts shall be installed in a vault."

More will be said about the subject of gas generation in succeeding paragraphs. It suffices to say here that the judgment of the local inspector applies to those cases where venting or gas absorbers must be applied. In general, modern buildings are sufficiently well ventilated to eliminate this requirement.

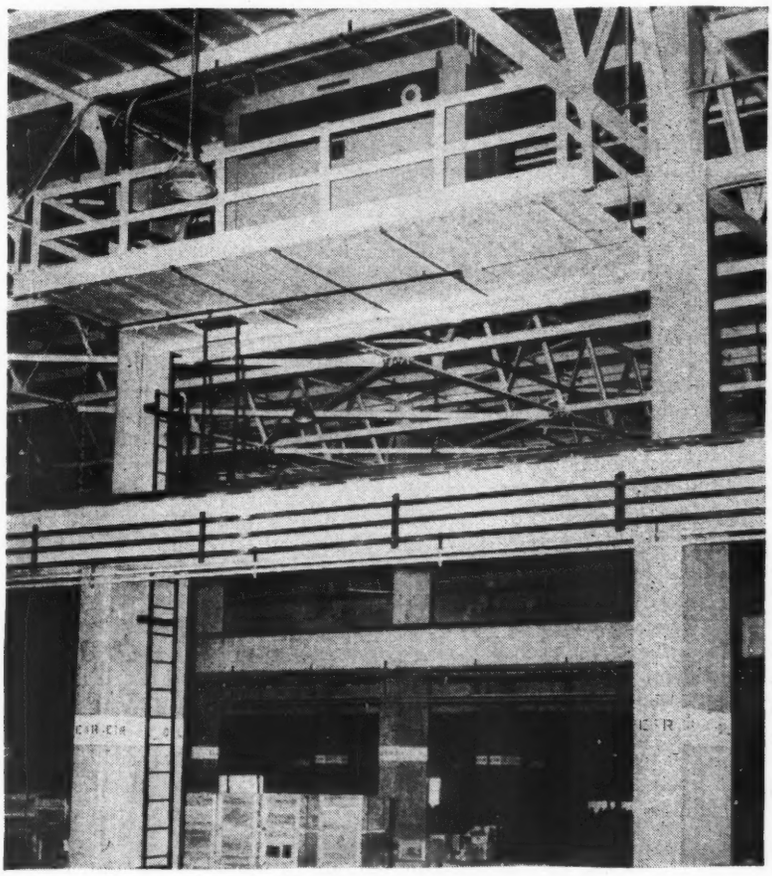
Economic and Engineering Comparison of the Two Types.

The economic factors of principal consideration in comparing the two different types of transformers are: first cost or purchase price, anticipated transformer life, and operating cost as reflected by the comparative transformer losses and installation cost. These factors can be summarized as follows:

1. *Price.* Class B insulated dry type transformers and askarel insulated transformers are considered equally well adapted for many types of installations. This tends to develop a competitive market and consequently the purchase price is usually the same for an equal bill of material.

2. *Losses.* The totals of the no load and copper losses of the Class B insulated dry type and askarel insulated transformers are approximately the same. The distribution of these losses between no load and copper losses is different in the two types, depending on the size and voltage of the transformers and the service for which they are to be used. The evaluation of these losses for the two types may at times prove helpful in making a selection of one type or another. Usually this distribution of losses is a secondary consideration, particularly in industrial applications, and for practical purposes the two types may be considered as equally satisfactory.

3. *Installation Cost.* The installation costs of both Askarel and Class B in-



Class-B-insulated dry-type load center unit Substation located on the roof trusses of a large manufacturing building. This unit is one of eleven similar units supplying power for high bay lighting.

sulated dry type transformers are relatively low, since the installation of either type is quite simple. It will normally be found that there is little difference in the cost of installing either type. In general, dry type transformers are lighter than askarel insulated units and at times this may be advantageous, particularly if the units are installed overhead.

Other factors that are of interest in comparing the two types of transformers are:

1. *Location.* In dry type transformers a basic part of the transformer insulation is the air in the spaces between the windings, leads, and terminal parts. Air circulation through the windings is also essential in the dissipation of the heat resulting from the transformer losses. Thus the windings must be freely exposed to the air.

The designer of such transformers assumes the air is clean and dry such as is normally encountered where basic tests for insulation strength are made. Although it is to be expected that reasonable factors of safety will be incorporated in the design, it is fundamental that such transformers must be located where the air is reasonably free of contaminating materials such as dust, oil vapor, metal flyings, excessive moisture, acids, etc.

The problem goes further than the cleanliness of the air between live parts. The coil structure, having weight and being honey-combed with ducts for the free circulation of air, requires mechanical support which is usually obtained by the use of various types of insulators between live parts and ground. The surfaces of such insulators are an important part of the insulation strength of the transformer. The voltage stresses these surfaces will stand are dependent upon their cleanliness. Excessive moisture and dirt accumulation on these surfaces will lower their ability to withstand voltage.

Also the accumulation of dust and dirt will reduce the thermal capacity of such transformers. For example, the low voltage dry transformers installed in some areas of steel mills have been found to overheat badly while carrying normal load because of dust and dirt accumulations.

Dust accumulations may be removed periodically from dry type transformers by cleaning and blowing out with dry air. The success of such operations depends upon the degree of adhesion of the film to the rather complicated surfaces in the coil structure. Other contaminants as oil vapor, for example, may cause a sufficient degree of adhesion to make this cleaning operation difficult if not impossible.

It is thus evident that an important requirement for the sound application of dry type transformers is that they be located indoors, in locations reasonably dry and free from excessive dust, oil vapors, and acid fumes.

In askarel insulated transformers, the windings are immersed in a liquid contained in a sealed tank. Consequently the effect of atmospheric conditions is limited to their effect on the tank and on the bushings if they are exposed. As far as the transformer tank is concerned there is obviously little matter for concern except in the rare case of extreme acid concentrations or where the transformer may be frequently submerged. Since exposed bushing surfaces are fairly simple, it usually represents no problem to clean them when required. Thus askarel insulated transformers may be located at will with only very minor consideration of atmospheric conditions.

Consideration must be given to the location of askarel insulated transformers in order to meet the National Electrical Code requirements in the case of poorly ventilated areas. Where well ventilated locations cannot be obtained, added expense is involved in the purchase of a gas absorber or vent piping to the outside atmosphere.

2. *Impulse Strength.* All transformers in service may be subject to overvoltage resulting from lightning or certain types of switching surges. The American Standards Association has established impulse voltage test levels for liquid filled transformers which represent a yardstick of their ability to withstand such overvoltages. It is expected of every manufacturer that his liquid-immersed transformers will withstand tests of these levels. Askarel insulated transformers meet these requirements.

The characteristics of modern lightning arresters are such as to provide coordinated protection for apparatus capable of withstanding these test values. Consequently successful protection can be obtained for askarel insulated transformers with standard lightning arresters. It is considered desirable that askarel insulated transformers be so protected when they are connected to overhead lines exposed to lightning.

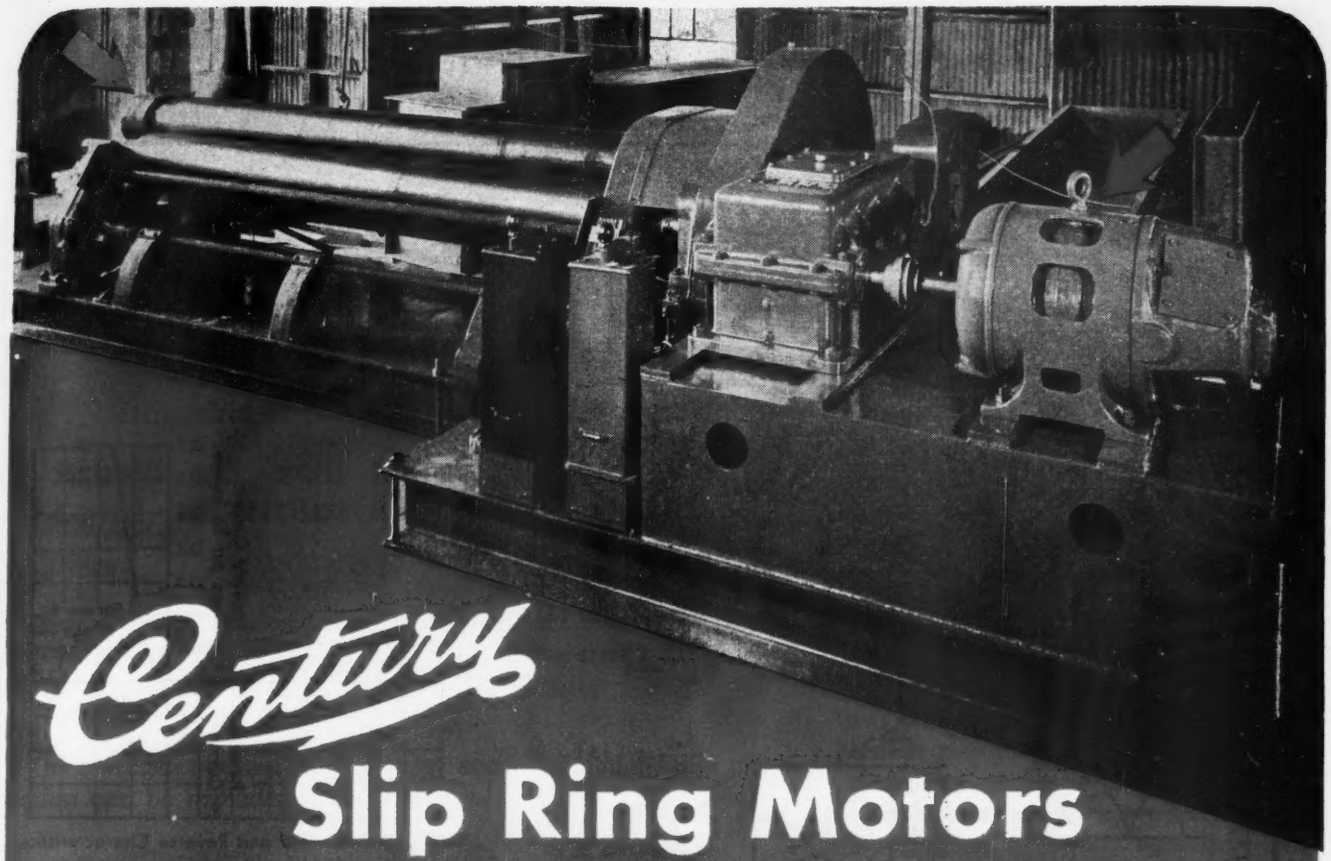
Similar impulse test levels have not yet been established for dry type transformers. Experience indicates that the probable levels that such transformers will withstand are somewhere between 50 and 75 percent of the values listed by the American Standards Association for liquid filled transformers. In the absence of definite values, it is not possible to make a precise statement relative to the ability of standard lightning arresters to protect dry type transformers. The margin of protection will unquestionably be less than for askarel insulated transformers. It seems sensible, then, that dry type transformers should not be connected to overhead circuits exposed to lightning unless extraordinary measures are taken for their protection.

3. *Audio Sound.* Both dry type and askarel insulated transformers when energized give off an audible magnetic hum. Experience with both types of units indicates that the noise level of the dry type unit might be somewhat higher.

In many cases this will not be an important factor but it should be borne in mind if a transformer is to be installed where the general sound level is relatively low.

Despite the fact that some differences are noted between the two types of transformers, it is not possible to draw any general and sweeping conclusions that one is superior to the other. That conclusion must be reached only after consideration of each particular application. For example, from what has been said above, the dry type transformer appears inferior from the standpoint of its ability to withstand lightning and adverse atmospheric conditions. Yet, if a transformer is to be installed at the top of an elevator shaft in a large office building where power is supplied to it by cable coming underground into the building, it is quite likely that these two factors would be of minor importance. The fact that the dry type transformer is lighter in weight would be a major factor in arriving at a selection.

Walter Post, assistant engineer-estimator, Hydon-Brand Company, Detroit electrical contractors, neatly files his blueprints and tracings for future reference.



Century

Slip Ring Motors

Provide Maximum Performance for Bending Rolls

- Varying Torque
- Speed Regulation
- Low Starting Current

In the installation shown here two Century Slip Ring Motors have been correctly applied. A 20 horsepower Slip Ring Motor drives the plate rolls and a 7½ horsepower motor raises and lowers the rolls to regulate the curvature of the plate that is bent.

These motors have the ability to start heavy loads with a minimum of starting current and the speed of the motor may be controlled to compensate for varying thicknesses of metal plate.

Another advantage of Slip Ring Motors is that the direction of rotation may be readily reversed when application requirements make it necessary.

Century motors are built in a wide variety of types, in sizes from 1/6 to 400 horsepower to meet nearly every electric power requirement. Century motors are engineered to the requirements of the machines they drive to assure top performance. Specify Century for all your electric motor requirements.

Century C MOTORS

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Offices and Stock Points in Principal Cities

DATA SHEET

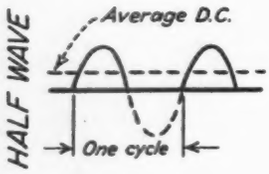
The number at the right is a classification for convenience in filing and for a future data sheet index

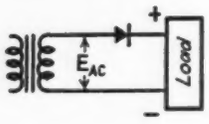
RI

Circuits For Selenium Rectifiers

SINGLE PHASE

HALF WAVE





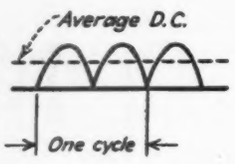
$E_{AC} = 2.3\ E_{DC} + DV$

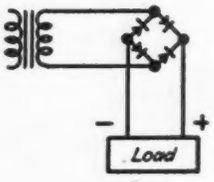
$I_{AC} = 1.8\ I_{DC}$

RIPPLE FREQ. = f

APPROX. RIPPLE = 160%

BRIDGE





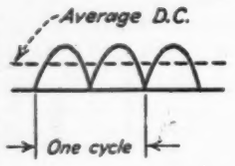
$E_{AC} = 1.15\ E_{DC} + DV$

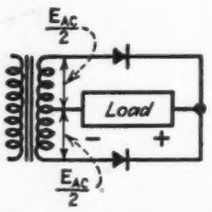
$I_{AC} = 1.15\ I_{DC}$

RIPPLE FREQ. = 2 f

APPROX. RIPPLE = 57%

CENTER TAP





$\frac{E_{AC}}{2} = 1.15\ E_{DC} + DV$

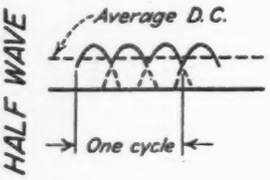
$I_{AC} = .8\ I_{DC}$

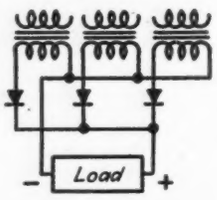
RIPPLE FREQ. = 2 f

APPROX. RIPPLE = 57%

THREE PHASE

HALF WAVE





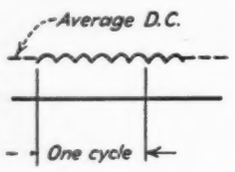
$E_{AC} = .86\ E_{DC} + DV$

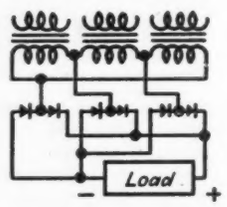
$I_{AC} = .65\ I_{DC}$

RIPPLE FREQ. = 3 f

APPROX. RIPPLE = 20%

BRIDGE





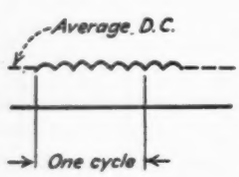
$E_{AC} = .74\ E_{DC} + DV$

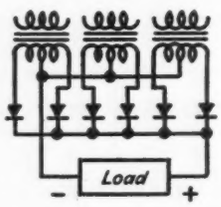
$I_{AC} = .85\ I_{DC}$

RIPPLE FREQ. = 6 f

APPROX. RIPPLE = 4.5%

CENTER TAP





$\frac{E_{AC}}{2} = .74\ E_{DC} + DV$

$I_{AC} = .46\ I_{DC}$

RIPPLE FREQ. = 6 f

APPROX. RIPPLE = 4.5%

Six common circuits in which Selenium Rectifiers are used, together with approximate wave shapes under resistive load, ripple frequency, ripple percentage and approximate a-c / d-c ratio.

E_{AC} = Approx. a-c Input Voltage (R.M.S.)

E_{DC} = Average d-c Output Voltage

DV = Voltage drop in Rectifier (R.M.S.)

I_{DC} = Average Direct Current Output

I_{AC} = R. M. S. Alternating Current

f = Input Frequency

$\%\ \text{RIPPLE} = \frac{\text{RMS d-c RIPPLE COMPONENT}}{\text{AVERAGE d-c VOLTAGE}}$

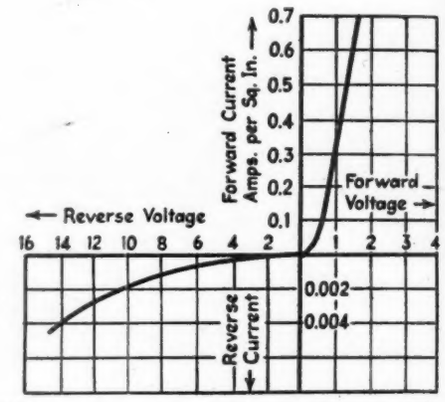


FIG. 1 D-c Forward and Reverse Characteristics.

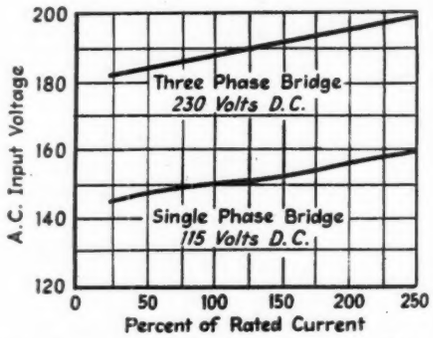


FIG. 2 A-c Input Voltage for Typical Rectifiers.

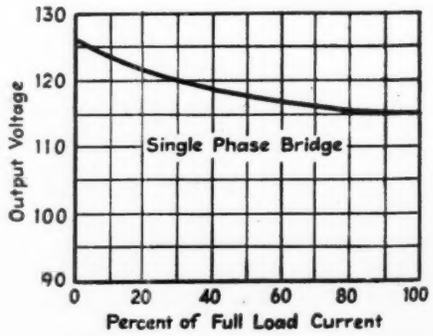


FIG. 3 Output Voltage Variation with load-Typical Rectifier.

Courtesy Radio Receptor Company, Inc.

Eliminate Shutdowns—Keep Things Running

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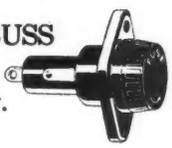
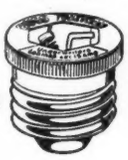
To safeguard Coils, Solenoids, Transformers, etc., the protective device must have a time-lag long enough to hold normal starting currents or harmless overloads. Yet it must open to protect, should something go wrong.

Fusetrons because they combine a fuse with a thermal cutout can give this kind of protection and prevent burnout of such apparatus.

HERE'S ALL YOU NEED TO PROTECT COILS, SOLENOIDS AND TRANSFORMERS.

A Fusetron of proper size, plus a fuse block— or a BUSS fuse-holder. 

On voltages up to 125, the same accurate, dependable protection can be provided with

a proper size plug Fusetron  or a Fustat, plus a fuse block.

Why risk a costly and troublesome repair or replacement job—and take a chance crippling plant or building operations, when Fusetron protection is so simple and inexpensive?

What is the FUSETRON?

The Fusetron is a Dual Element device—a Fuse to which is added a Thermal cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimension as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere in both 250 and 600 volt types. Also in temper-resisting type (Fustats) for 125 volt circuits.

Their cost is surprisingly low.

Fusetrons Give Many Other Kinds of Protection Heretofore Not Available

Fusetrons do everything fuses do, as is confirmed by the Underwriters' Laboratories Label, and in addition...

★ Provide simplest way to stop burnouts from single phasing. ★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads. ★ Give thermal protection to panelboards and switches. ★ Prevent needless blows caused by heating in panels and switches. ★ Permit use of larger motor or adding more motors on circuit without installing larger switch or panel. ★ On new installations, proper size switches and panels can be used instead of oversize. ★ Protect motors against burnout. ★ Give double burnout protection to large motors. ★ Make burnout protection of SMALL motors simple and inexpensive.

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Don't risk avoidable losses. One burned out solenoid—or one needless shutdown—or one destroyed panel may cost you more than replacing every fuse with a Fusetron.

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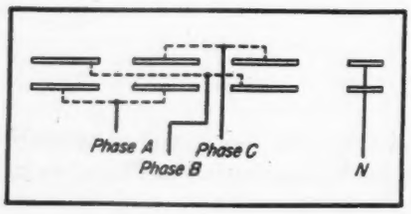
QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

Reader's Quiz

Bus Duct Connections

QUESTION 236—I recently installed some 2000 ampere, 3 phase, 4 wire bus duct. It consisted of two bars ¼ inch by 4 inch copper per phase and two bars of ¼ inch by 2 inch for the neutral.



The bars were factory connected as shown in sketch by dotted lines. Can someone tell me why they were so connected? —W.H.M.

A. TO QUESTION 236—The bars in the bus duct were connected as shown in order to lower the inductive reactance of the circuit and also to more nearly equalize the reactances. This results in a lower voltage drop and less unbalance of voltages as compared with other arrangements of connecting the bars.

The reactance of the bus circuit will vary with the frequency, spacing of bars, arrangement of bars with respect to each other and the material. The closer the bars connected to the different phases are to each other, the lower will be the reactance. The effects known as skin effect and proximity effect also have a decided effect on the current carrying ability of the bus. The inductance of a conductor being greater at the center causing the current to flow at the outer edges. Proximity effect causes unequal distribution of current due to unequal voltages being induced in the various conductors. The arrangement of bus bars shown minimizes the current unbalance and thereby increases the current carrying ability of the bus. —R.M.B.

A. TO QUESTION 236—The bus bars in your question were connected, as you showed in your sketch, to compensate for reactance losses. It is common practice in transmission line construction to transpose the positions of the current carrying conductors to balance out inductive and capacity reactances that exist between conductors, that is, providing it is difficult to uniformly space the distance between conductor. In bus bar construction where large currents will be carried, it is difficult to uniformly space the conductors, so the same effect is obtained by transposition.—T.O.B.

A. TO QUESTION 236—The purpose of arranging the bus connections as shown in the sketch is to reduce the self inductance of the bus. An inspection of the connections reveals that each of the vertical pairs of "line" bus bars is connected to a different phase. Thus, on the left side the lower bus bar is connected to phase "A" and the upper bus bar is connected to phase "C". The average current in each of these bus bars is 120° out of phase, therefore, the average self-inductance is also 120° out of phase and hence each bus bar tends to cancel the inductance of the other.

The net result of this scheme of connections is to reduce the eddy currents in the individual bus bars, and in the enclosing metal shield, thus reducing the energy loss of the bus and the reactance and voltage drop.

The neutral bus bars normally carry little or no current and consequently do not contribute to the energy and voltage losses.

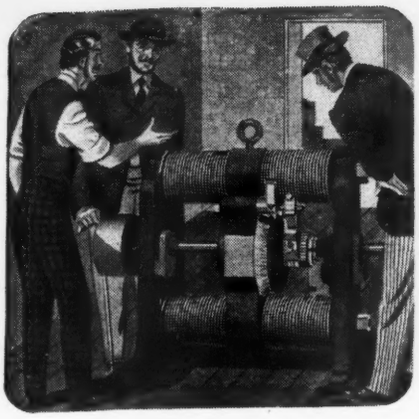
A. TO QUESTION 236—The reactance of the circuit will decrease and the power factor will increase as the conductors of each phase are brought closer together. The bus bars are arranged in this manner to give equal spacing and equal reactance between each of the 3 phases. The bus bars of opposite phases are as close together as insulation and sound construction will permit to minimize the reactance.—J.C.S.

A. TO QUESTION 236—There are several reasons why the manufacturer resorted to the bus arrangement you mention. Of first importance, with this arrangement, your reactance voltage drop is definitely minimized. Such an arrangement is a form of "interleaved phases."

In this problem, phase A, B and C each have two bars in parallel. Now, in d-c applications, capacity may be increased by merely adding bars in parallel as the current density is uniform per bus; however, in a-c work, additional bars in parallel do not increase the capacity in similar proportion due to the "skin effect" encountered. We therefore resort to "multi-phase" or interleaved buses. Another contributing factor to reactance drop is the "Proximity Factor" and this is manifested when two or more conductors carrying current are close enough to each other to be within each others magnetic influence. This causes an even more uneven current distribution throughout the bus which is same as saying a higher a-c apparent resistance. With this arrangement, we are paralleling bars, hence halving our load per bus and proportionately decreasing the fields per bus. Thus the proximity effect is lessened. The arrangement therefore minimizes reactance drop by raising the a-c conductivity of the buses.

Of lesser importance but of interest is the justification of using parallel bars for short circuit stress possibilities. Any handbook will show formulas for calculating forces between live conductors due to the magnetic fields present. An important factor of such equations is the current. By paralleling, current per bar is reduced thus proportionately decreasing the distortive effects which might occur on a short circuit.—E.A.M.

A. TO QUESTION 236—A conductor carrying a heavy alternating current—in the order of thousands of amperes—produces a consid-

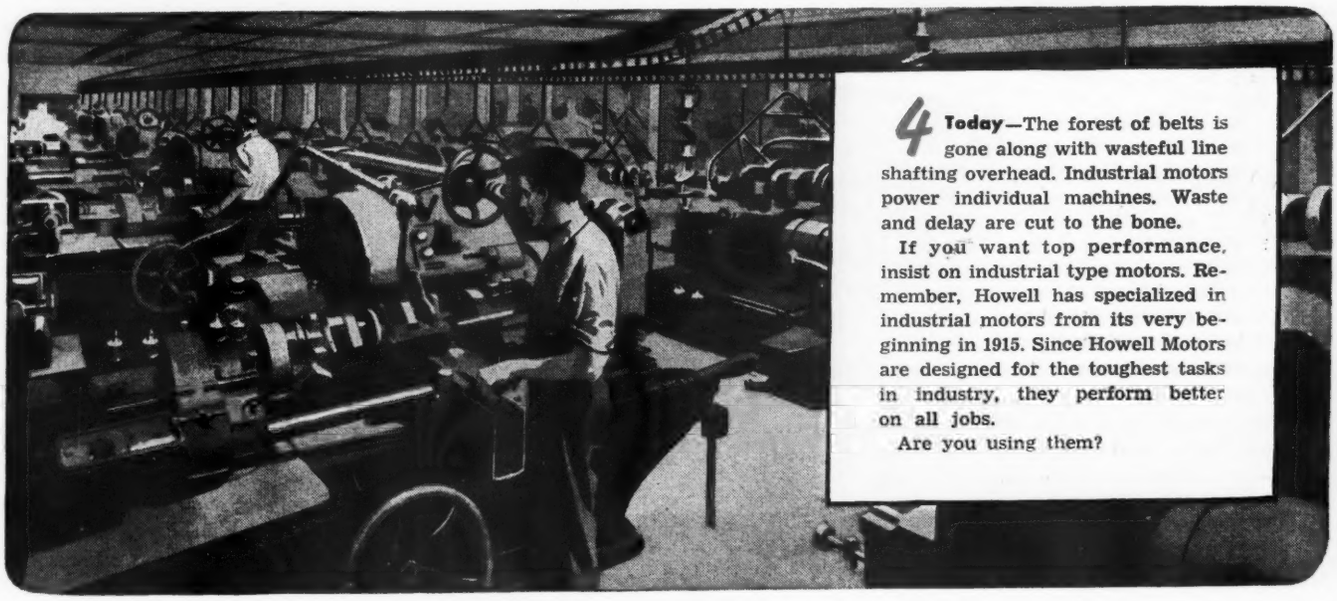


1 1870—The first electric motor was discovered by accident. Its invention revolutionized the lives of millions. Graphically, here's how its development changed you from a walker to a rider.

2 1897—The first automobiles were built by "hand." They were a luxury for the few. Mass production methods with batteries of electrically driven machines to cut manufacturing costs were still to come.

3 1925—Mass production had arrived. Machines driven by electric motors were more extensively used. Prices of cars came down. Walkers became riders. But shops looked like a forest of belts.

"Presto! and out went the forest of belts"



4 Today—The forest of belts is gone along with wasteful line shafting overhead. Industrial motors power individual machines. Waste and delay are cut to the bone.

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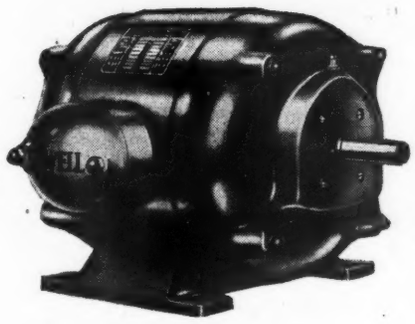

Howell Protected Type Motors available in sizes 5 h.p. and smaller. Also other Howell industrial type motors available up to 150 h.p.

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erable electromagnetic field around itself. If a second conductor is within this field, an induced voltage can be measured between its ends. If this second conductor, too, carries a heavy current, it induces a voltage in the first. If these two conductors form part of a closed circuit, say two legs of a three-phase system, the induced voltages may add. This voltage, then, produces a circulating current which is superposed to the load currents. As a consequence, the currents in the two conductors will become unequal, say 2,300 and 1,700 amps., instead of 2,000 amps. in each, and overheating may result.

To minimize this effect, the conductors are subdivided and "interlaced". For four conductors per phase, the following arrangement has been found to be best:

A C A . B C B
B C B A C A

—L.F.R.

Single Phase Motors

QUESTION 237—I would like to use a single phase motor on a small lathe and have it so connected to a control whereby I could easily reverse the motor's speed (that is, full speed in one direction to full speed in the other). If it can be done, then what type of single phase motor would you suggest I purchase, and in what manner would the reversing be done?—E.J.K.

A. TO QUESTION 237—There is only one type of single phase motor adaptable for plugging service, Universal, or series a-c motor. It has its limitations, but I don't believe they would apply in your case of needing one for a small lathe. In your order you would specify the horsepower (not over one), the rpm. (3500 would suit your needs), two stator winding (for reversing service), and of the non-compensating type, (unless your dealer can furnish you a reversible compensating motor). The reversing would be accomplished with a single pole double throw switch with the common point connected to one side of the supply and the other points connected to the two different stator windings. The reversing takes place electrically the same as in reversing a series d-c motor, by reversing the magnetic effect between the armature and the stator.—T.O.B.

A. TO QUESTION 237—For the single phase motor on the

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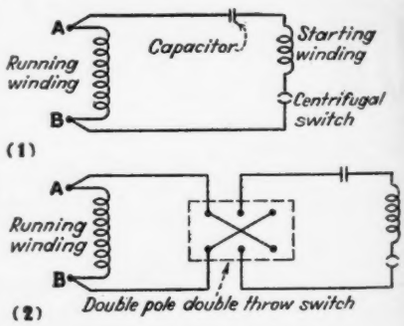
small lathe which you desire to reverse, it will depend on just the service you desire as to the type of motor you should buy. Almost any single phase motor can be used with a reverse switch to reverse the direction of the motor provided the motor is allowed to come to a stop before the switch is thrown into the reverse position. The diagram accompanying the motor and the reverse switch will usually show the exact connections. If, on the other hand, it is your desire to immediately throw the switch from a forward position to a reverse position without allowing the motor time to stop, then it would be necessary for you to specify an instant reverse single phase motor. They are quite a bit more expensive than the standard motors, but you can reverse the direction from full speed in one direction to full speed in the opposite direction by merely throwing your reverse switch.—L.R.B.

A. TO QUESTION 237—To be able to reverse the rotation of a single phase motor it is necessary to interchange the connections of the starting winding. This can be done by connecting the starting winding to a double pole double throw switch or a reversing switch as used on machine tools such as lathes.

To locate the starting windings, it will be necessary to open the motor to get at the connections. Remove the end bell on the side where the coil connections inside the motor are made. The starting winding leads can be traced by several methods: 1—The starting coils are of smaller size wire.



2—These coils are generally placed at the top of the slots. 3—One connection goes to the centrifugal switch. 4—On capacitor motors one connection is made to the capacitor. Bring out the two leads corresponding to the starting winding and connect as shown in sketch, (2).

Sketch No. 1 shows the connections of a capacitor type motor. The type of motor to be used is a capacitor start motor. It is easily reversed, starting torque is high, there are no brushes and it is very rugged.—A.L.

Motor Shops

Rewinding Charts For Polyphase Motors

To eliminate the necessity of calculating wire size and number of turns for rewinding and reconnecting changes in polyphase motors, the NISA National Certification Board has developed the two charts (Bulletin 294) illustrated below.

Charts 1 and 2 indicate, at a glance, the number of turns per coil, wire size and connection (Y, delta and plus and up to six multiple circuits of each) for a new winding that will produce the same operating characteristics as the original winding when the following is desired:

1. A different connection
2. A different size of wire
3. Change from two to three-phase and vise versa.

The charts *do not* provide windings for change of speed. Speeds can sometimes be changed one step (i.e., 1200 to 900) but this is always risky. A two-step speed change (i.e., 1200 to 720) is a dangerous venture even if the number of slots seems to permit it. The Rewind Data Bureau of the National Certification Board, NISA, never recommends making speed changes, hence presents no data on the subject.

A change of wire size and connection can frequently be used in an emergency without altering original operating characteristics. A motor with an original winding consisting of 15 turns per coil of No. 16 wire, connected Y-Y can be rewound with 26 turns per coil of No. 18 wire when connected double-delta. The coil pitch remains unchanged. Likewise, a two-phase motor may be rewound for three-phase operation. For example: An original two-phase winding of 20 turns per coil of No. 17 wire connected double-plus can be rewound for three-phase operation with 17 turns per coil of No. 16 wire connected Y-Y; or with 29 turns per coil of No. 19 wire connected double-delta. The coil pitch remains unchanged.

To explain the use of the charts, the examples cited above are applied.

Problem: A three-phase motor to be rewound has an original winding of 15 turns per coil of No. 16 wire connected Y-Y. How can this motor be repaired if no No. 16 wire is in stock?

Solution: This motor can be rewound with a double-delta connection. On Chart 1, go horizontally along the 15 turn line to the intersection with the Y-Y curve; then vertically to the intersection of the double-delta line. Following horizontally (left) at this point will show 26 turns per coil. To find the wire size use Chart 2. Follow horizontally along the No. 16 line to the intersection of the Y-Y curve; then vertically to the double-delta

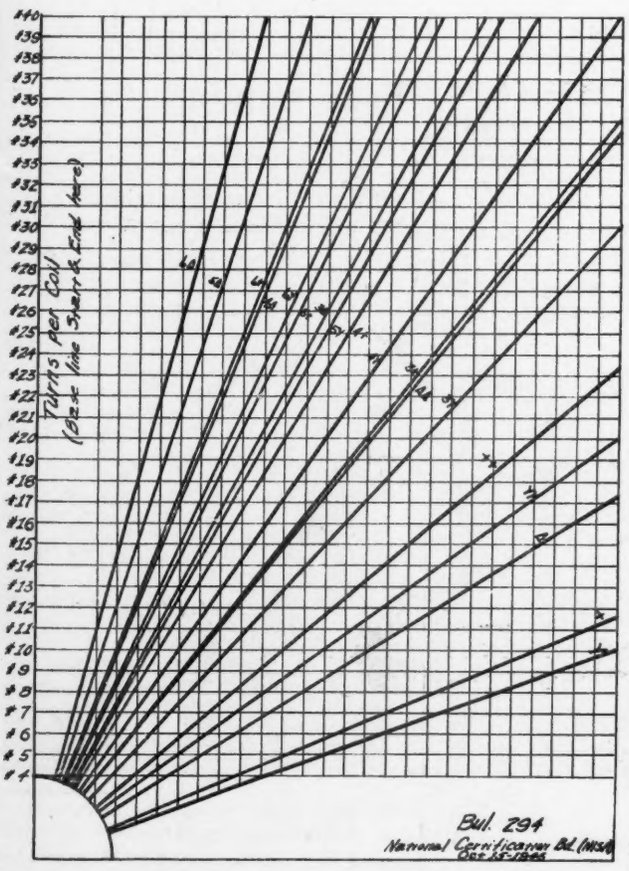


CHART 1—indicates number of turns per coil for various connections of new windings. Vertical axis represents "turns per coil." Starting point is number of turns per coil of original winding.

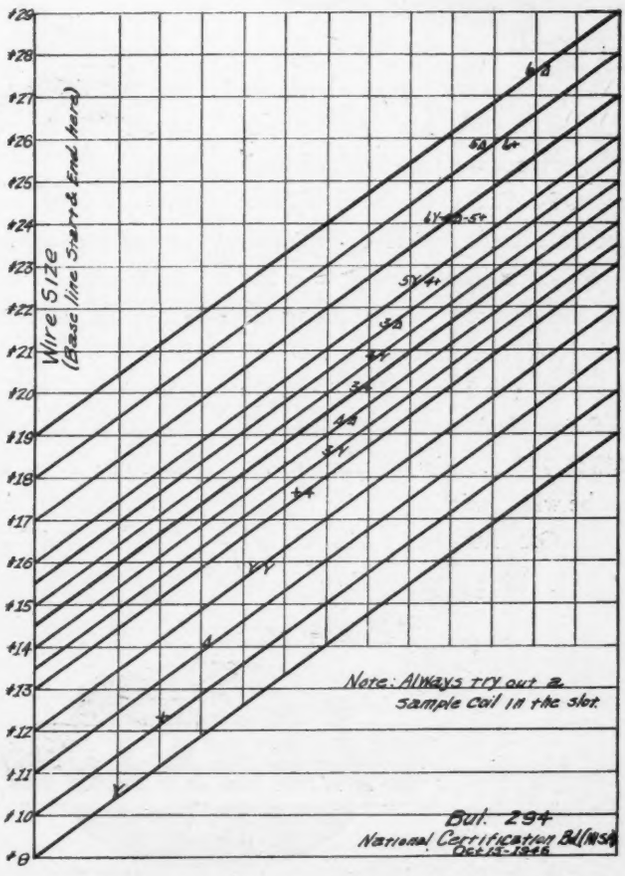


CHART 2—gives the wire size for new windings conforming to various connections. Vertical axis represents wire sizes. Starting point is wire size of original winding. Use of chart is explained in above examples.

"GREENLEE BENDER
pays for itself on one job"

"On one recent conduit job alone, our GREENLEE Bender has paid for itself through labor and materials savings," reports Mr. E. O. Matz, head of Matz Electric & Radio Co., Harlingen, Tex.

"Moreover," he continues, "it has paid for itself many times during the period it has been in service . . . labor savings run as high as 50%, savings on fittings and manufactured bends, 50% to 75% . . . this company would not be without it!"

Let a GREENLEE make valuable time and materials savings on your jobs, too. With it, *one man* can quickly make smooth, accurate bends in rigid and *thin-wall* conduit, pipe up to 4½", tubing, bus-bars.

Whatever your bending job, there's a GREENLEE to do it faster, smoother, better. Write for complete facts. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1742 Columbia Avenue, Rockford, Illinois.

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FOR THE CRAFTSMAN

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK
Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

curve; then horizontally to the left at this point and No. 18 wire is indicated. The new winding will be 26 turns per coil of No. 18 wire, connected double-delta.

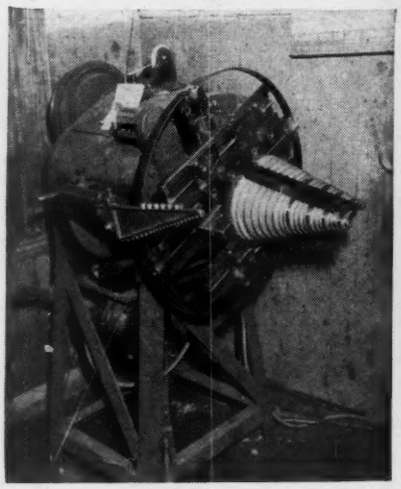
Problem: Rewind a two-phase motor for three-phase operation, the original winding being 20 turns of No. 17 wire connected plus-plus.

Solution: Follow horizontally along the 20-turn line on Chart 1 to the intersection of the plus-plus radial line; then go vertically (downward) to the Y-Y radial line; then horizontally to the left at this point and 17 turns per coil are indicated. To find wire size, use Chart 2. Go horizontally along the No. 17 line to the intersection of the plus-plus line; then down to the Y-Y line; then horizontally to the left at this point where No. 16 wire is indicated. The new winding will consist of 17 turns per coil of No. 16 wire connected Y-Y.

General assumption is that the user of the Charts understands motor windings well enough that he will not attempt changes that are mechanically impossible or impractical. Frequently the number of slots will not permit certain changes. Also, the winder must not try to put a triple connection on a four-pole motor.

Square Grooves For Coil Winder

Concentric-field coil-winder heads form more exact coils, permit the individual wires to form without bunching and promote a neater and flatter final assembly when the bottoms of the



Physical appearance and compactness of single-phase motor concentric-field coils are improved when bottoms of slots on coil-winding head are flat. Shop-filing grooves of some early models change bottoms from original slope to suggested condition.

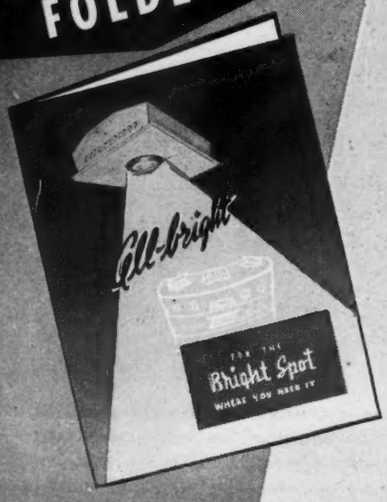
It's the Bright Spot

THAT COUNTS

MERCHANDISE UNDER THE BEAM *With* All-bright RIGHT SPOT UNITS

ALL-BRIGHT—the duo-purpose, compact, space-utilizing, display light of tomorrow. One unit combines a soft-focus aura of light for background and an incandescent flood to spot and dramatize and increase sales. Before planning to build or remodel your office, factory or store display, see All-Bright—the fixture of the future!

SEND FOR ILLUSTRATED FOLDER



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LIGHT RIGHT WITH ALL-BRIGHT

All-bright ELECTRIC PRODUCTS COMPANY
3917 - 25 N. KEDZIE AVENUE • CHICAGO 18, ILLINOIS

New!

KENNADRILL*

Saves 7½ Man Hours in One Day

FOR ELECTRICAL CONTRACTOR

Speeds Up ROTARY DRILLING of Masonry

- TAKES HOLD QUICK!
- CUTS CLEAN!
- DRILLS FAST!
- CAN'T STALL!
- STAYS SHARP!

Often an electrician *must* drill holes in brick, tile, stone, or cement preliminary to a wiring job. Time saved on such work enables skilled men to stay at their real trade and do easier, faster wiring. One electrical contractor using Kennadrills reports: "Saved 7½ man hours the first day we used the Kennadrill, which permitted us to move to another job a day ahead of schedule."

Kennadrills save time and labor drilling holes in *all types of masonry*. They replace the noisy, nerve-racking, tedious method of piercing with percussion drills, or hammer and chisel.

Inserted in any standard rotary electric drill they easily cut through all types of non-metallic construction materials—in a hurry. Here's why—they are tipped with Kennametal—the metal that is far harder and more durable than tool steel. It takes hold fast, cuts clean, drills true, and keeps a keen edge under the heat and abrasion of cutting.

Available in following diameters: ¼", 5/16", ⅜", ½", 5/8", ¾", ⅞", and 1". Ask your jobber, or write for particulars and prices.

Distributors Wanted!

Write for particulars, telling us territory you cover.

*Kennadrills have cutting tips of the "magic metal" of the war—cemented hard carbides known as Kennametal, that helped America's metal-cutting industry to multiply its output at a fraction of previous costs.

KENNAMETAL

SUPERIOR CEMENTED CARBIDES

TRADE MARK REG. U. S. PAT. OFF.

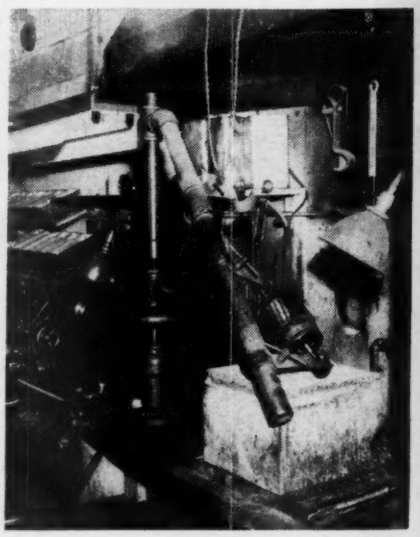
KENNAMETAL Inc., LATROBE, PA.

individual grooves are flat or perpendicular to the plane of the component coils. Although the majority of manufactured coil winding heads are now including this feature, many of the earlier heads allowed the bottoms of the grooves to follow the slope of the split cone base. The earlier models had multiple ridges or lips dividing the sloping surface into a series of wire confining grooves but the wires had a tendency to bunch towards the outer or lower section.

This can easily be corrected by shop filing the grooves so that the bottoms are flat. The Northeastern Electric Company of Boston made this slight change and reports that the coils produced now fit together more compactly and result in a neater, more compact product.

Soldering Small Armature Leads

Soldering coil leads to small, flat type commutators is accomplished rapidly, simply and economically in the motor repair shop of H. N. Crowder Jr. Company, Allentown, Pa. A hand wheel and collar revolve and move vertically along a jack-threaded 1½ inch pipe erected on a metal shop bench. Raised and lowered by the collar is an acute-angle pipe boom which extends outward and downward from the upper limit of the threaded guide pipe. Two cantilever cradles are attached to the end of the boom and can be adjusted for distance along the boom by large hand screws. The boom is adjacent to a solder pot which is gas fired and severed by a venting exhaust hood.



Shop constructed rig lowers edge of flat type commutator into solder pot for soldering leads. Equipment consists of pipe assembly, jack screw and twin adjustable cradles.

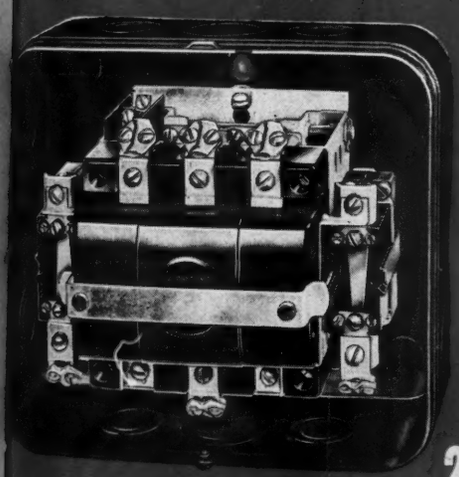
RIGHT ANGLE TYPE "RA" MAGNETIC STARTER

ARROW AH HART

NEW No.2

NEW PRINCIPLE • BALANCED MECHANISM

1



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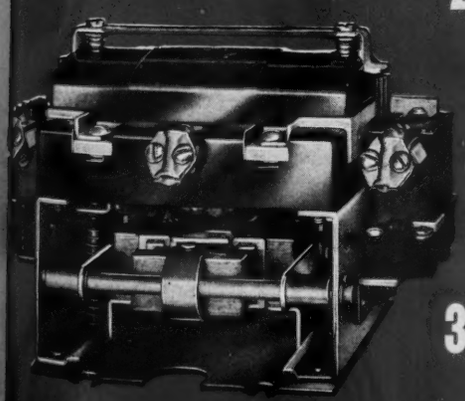


3

(1) *Small, compact* Here's the smallest Size 2 Starter ever developed — and having the biggest contacts. Dimensions with Enclosure: 9⅛" width: 8⅛" height; 5" depth.

(2) *Easy-to-wire* Designed for straight-through wiring. Line wires connected at one end and load wires at opposite end. Compact mechanism leaves more wiring room in box.

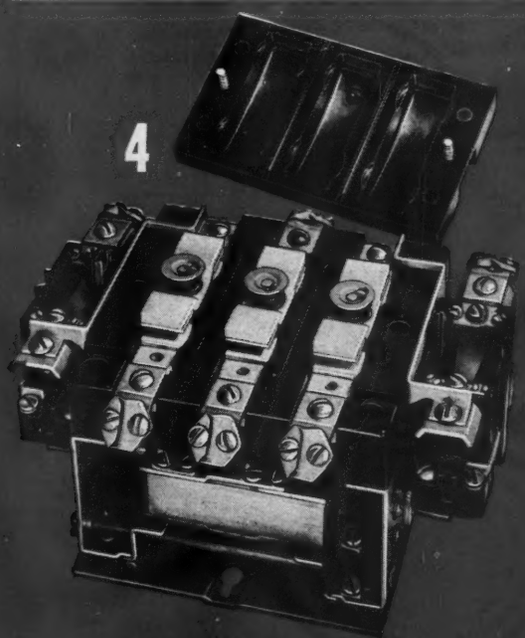
(3) *Fast hook-ups* Terminals front-wired; easy to get at. Connecting wires can be cut even. Straight-through wiring eliminates bending or forming heavy lines.

(4) *Arc control* Shape of contacts, and broad line of contacting area cuts the arcing to a new minimum. An individual arc chamber completely encloses each contact.

This switch makes use of a new, *original* development in solenoid starter mechanism,— not merely an improvement but a basic new operating *principle.* The Right-Angle BALANCED mechanism multiplies the 15-pound magnet pull to 25 pounds at the contacts, requiring but 8.5 Watts closed and 75 Watts inrush. Only the magnet plunger of 7 ozs. weight, works against gravity when the magnet is closing. The Right-Angle moving mechanism is *balanced* to provide full use of magnet power without lifting extra weight. Contact carrier is guided in perfect alignment in straight-line horizontal action, bringing equal contact pressure to each pole. This new-type action is engineered to produce a switch about *half the size* of the conventional motor starter... Write for illustrated 4-page folder giving out the full particulars of the features you'll want in your Starters from now on!

INDUSTRIAL CONTROL DIVISION

ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD 6, CONN.



4

Contacts

Illustration below shows design of long-life contacts. Curved movable tips against flat stationary tips give a broad line-of-contact surface which improves with use.

TYPE "RA"

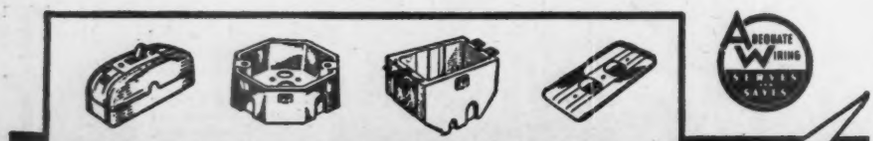
PORCELAIN GETS THE OK

MEET R.E.A. REQUIREMENTS and DO A BETTER JOB on FARM WIRING!

● Safe wiring is a MUST for consumers served under the Rural Electrification Administration! The new R.E.A. "Specifications for Wiring" point the way to safety with approved materials and methods... giving an O.K. to the PORCELAIN way!

Porcelain Outlet Boxes and Porcelain Protected Wiring best serve the requirements of R.E.A., which stipulate that *non-metallic* outlet boxes shall be used with knob and tube and non-metallic sheathed cable wiring.

Whether it's farm or city electrical work — PORCELAIN offers unbeatable time-proven advantages for safe, durable, economical wiring. Ask your Electrical Inspector about non-metallic wiring with Porcelain for safety. Write for wiring manual.



ADEQUATE WIRING MEANS SAVES

PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO

Wire Today for Tomorrow's Load

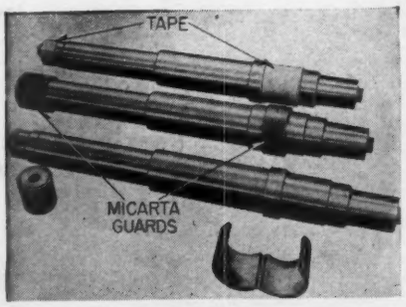
Soldering the leads is performed by resting the small armature shaft in the two cantilever cradles, adjusting the hand wheel so that the boom carries the periphery of the flat type commutator to the surface of the molten solder, and slowly rotating the armature. The leads are automatically soldered, waste is eliminated by confining the solder to the melting pot, fumes and heat are drawn from the area through the venting hood and the job is accomplished with a minimum of effort. The simplicity of construction makes it possible for any motor shop to duplicate and the operation permits rapid and uniform manipulation.

Micarta Guards For Shaft Journals

Repair shops and manufacturing plants handling numerous shafts with like dimensional characteristics can protect their work or product through the use of micarta journal guards. After the finishing grind operations on shaft journals, considerable handling of the shaft is necessary before final assembly. If unprotected, the journal surfaces consequently become scarred and scratched.

E. J. Dick of Westinghouse's East Pittsburgh plant reports that these old methods can be replaced by micarta journal guards which are either threaded or hinged depending on their application. The hinged guard is secured to the shaft by wire wrapped around the pins on the hinged sections. The threaded guard consists of a section of micarta tubing into which is inserted a threaded washer.

These guards are applied to the journals after the finish grinding operation and left on throughout subsequent operations. They are returned to the original dispatching section by electric truck after a sufficient number have been accumulated.



Micarta guards for shaft journals are designed to replace former taping practices. Guards of two types, threaded and hinged, can be quickly applied to the journals after the finish grinding and left on during subsequent operations.

Modern Lighting

Eggcrate Ceiling Shields Slimlines

The luminous ceiling installation at TWA's new Chicago ticket office is one of the outstanding examples of modern planned lighting. Designed by Skidmore, Owings & Merrill, project architects, and Samuel R. Lewis and Associates, consulting engineers, the scheme utilizes continuous rows of slimline units effectively shielded by an eggcrate louver extending over the entire ceiling area.

Prime goal of the designers was to choose a concealed lighting system for the remodeled area that would (1) attract attention of the pedestrian; (2) blend with the ultra-modern lines of the office with its full length plate glass windows forming the south and west walls and (3) produce adequate, soft, evenly diffused illumination. After considerable study the overall louvered ceiling method (see Fig. 2) was chosen.

Twenty-nine continuous rows of lamps—on 24-inch centers—cover the main ticket sale and lounge area (55-ft. by 56-ft.). Each row is 54-ft., 2-in. long; has the 3-in. by 4-in. wiring trough set flush in the suspended ceiling with the axis of the lamps one inch below ceiling line; accommodates a single line of 8-ft. and 6-ft., 100 milliampere, daylight slimline lamps mounted end-to-end. To minimize lateral dark lines, socket mountings are staggered in adjacent rows. Lamps are fed by single or two-lamp high power factor ballasts as conditions require. Lamp sockets and ballasts are mounted to the wireways enclosed by removable white enameled cover plates. Between wiring troughs, sec-

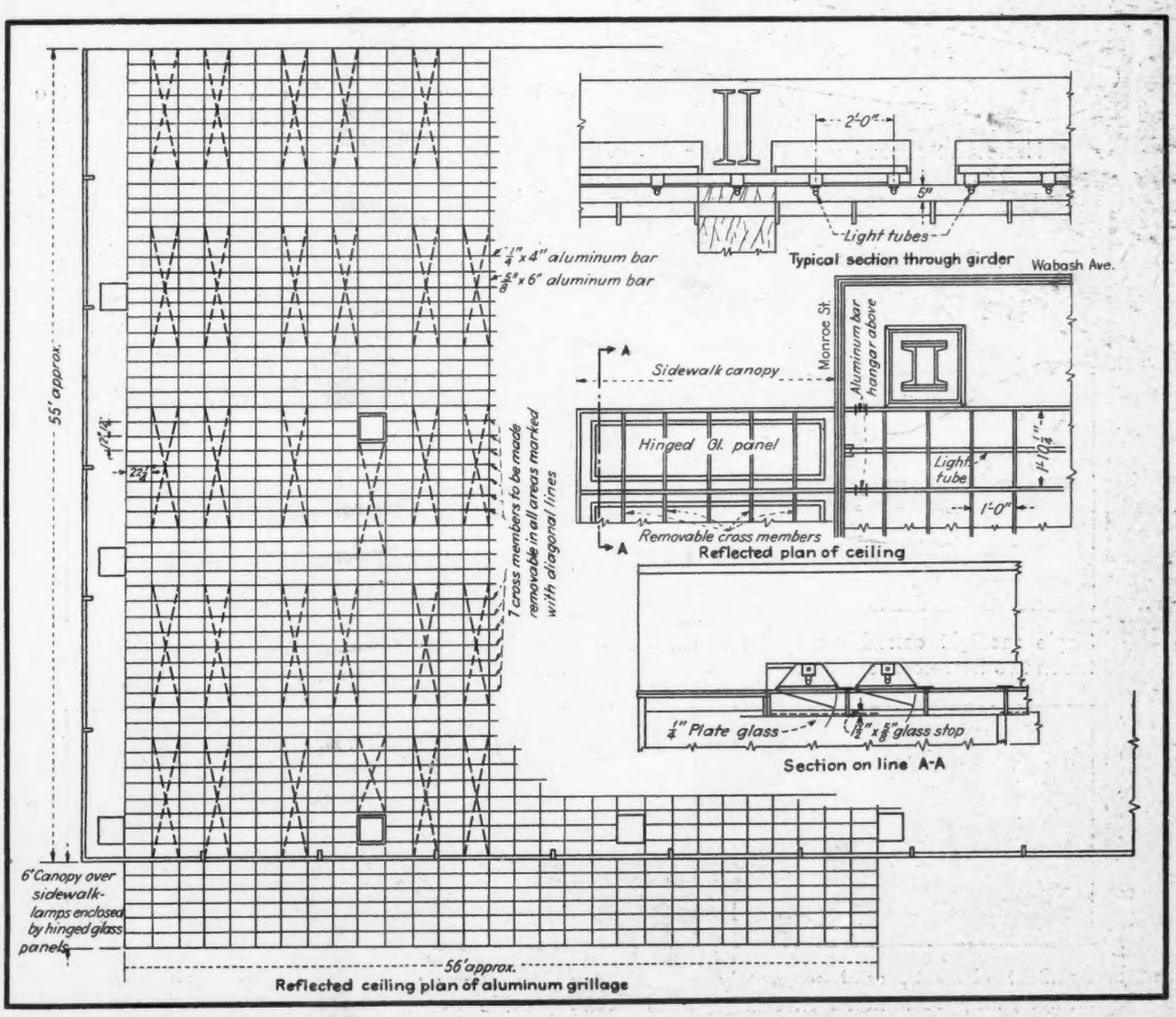
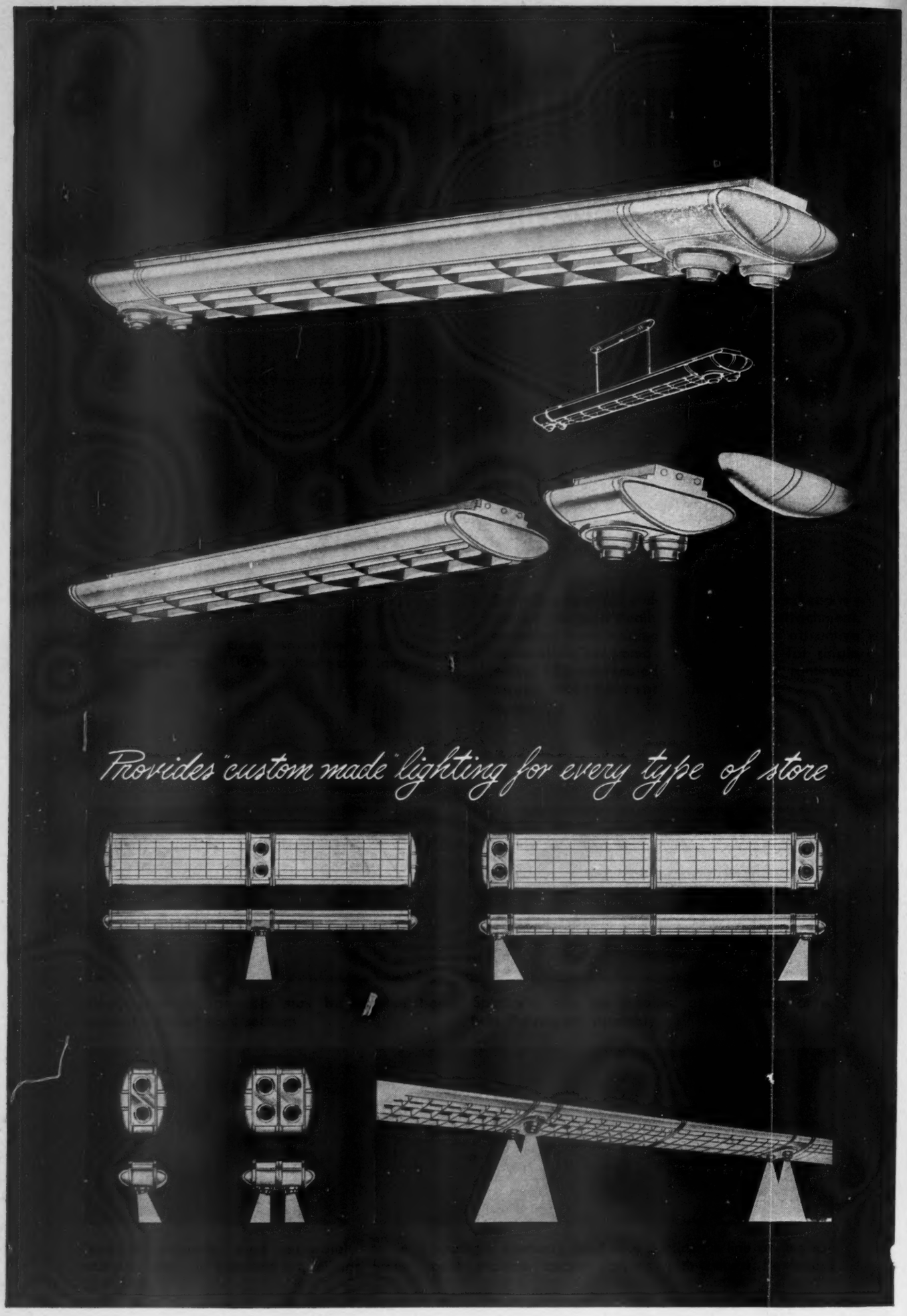


FIG. 1—Details of aluminum eggcrate louver ceiling wchich covers entire ticket office and lounge area. Note sections (diagonal lines) with removable cross members to facilitate maintenance and lamp replacement.

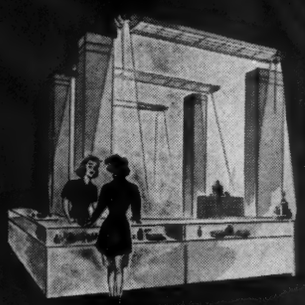

Provides "custom made" lighting for every type of store

The Merchandiser

Fluorescent

Incandescent

Now Combined



The new Westinghouse MERCHANDISER is more than just another "lighting fixture". It is the basis of a complete, *planned lighting system* for all types of retail stores.

The MERCHANDISER combines, in one attractive luminaire, the best qualities of fluorescent for general illumination—with those of the incandescent lamp for brilliant spot lighting of featured merchandise.

Through various combinations of fluorescent sections, spotlight elements and decorative end caps, a wide variety of planned lighting effects is possible for sales areas (see opposite page). No longer is it necessary to sacrifice smart appearance for high efficiency. The Westinghouse MERCHANDISER gives you both.

For maximum seeing comfort plus "saleability" in lighting . . . for harmonious appearance . . . for flexibility of display lighting . . . for economy of installation . . . recommend the smart, new MERCHANDISER when figuring store modernization or new construction. J-04106

Send for full information

For information on features and application of the MERCHANDISER, ask your near-by Westinghouse office for a copy of Folder B-3788. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

PLANNED LIGHTING

AVAILABLE THROUGH 127 WESTINGHOUSE ELECTRIC SUPPLY OFFICES AND INDEPENDENT DISTRIBUTORS

SPERO
DEPENDABLE
ELECTRICAL PRODUCTS

Spero offers you the convenience of 5 complete lines of electrical products from one reliable source.

1 VAPOR PROOF UNITS

Pendant or bracket types, for 3" and 4" outlet box or "x" Type mounting. With or without wire guard and reflector. 50 to 300 W.

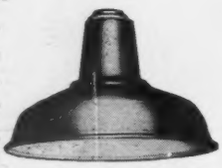
2 FLOODLIGHTS

Spero No. 55 & 65, 150 to 500 W.

Finishes in "Duralum"—sizes for lamps from 150 to 1500 W. Open types or outdoor weatherproof type with prismatic lens. Also yard lights.

3 REFLECTORS

Shallow and dome-type, one-piece seamless construction, keyless or with pull chain. For 25 to 750 W lamps.



Dome type for 60 to 200 W lamps.

4 MATERIALS FOR ELECTRICAL CONSTRUCTION

Die-Cast Sockets with approved porcelains are just one of the items we manufacture for use in electrical construction.

Vertical or 90° angle mounting.

5 FLUORESCENT FIXTURES

SPERO also manufactures more than 30 types and sizes of fluorescent units.

Spero products are distributed only through recognized wholesalers. Write for Bulletin No. 10.

Look for another Spero Advertisement On Page 21

THE SPERO ELECTRIC CORPORATION
18222 Lanken Ave., Cleveland 19, O.

FIG. 2—Interior view of TWA ticket office in Chicago's Loop. Aluminum grid ceiling shields continuous rows (24-inch centers) of slimline lamps which provide an average of 35 footcandles on the working plane.

tions of ⅜-in. gypsum board form the ceiling.

Branch circuit conductors (No. 12 wire in thin-wall tubing) emanate from a 120/208-volt, 3-phase, 4-wire circuit breaker distribution panel. Individual breakers control three adjacent strips of lighting units.

Suspended about five inches below the ceiling and covering the entire 55-ft. by 56-ft. area is the eggcrate grid constructed of aluminum bars with a brushed finish to reduce surface brightness to a minimum. The bars have fully machined keyed type joints designed to permit thermal expansion and contraction. Flat head machine screws, threaded through the bars and keys, fasten the 26 sections of the louver into a single unit. Lateral components of the louver (¼ in. by 4 in. bars) are spaced on 12-inch centers; parallel components (⅝ in. by 6 in. bars) are on 22¼-inch centers. Aluminum bar hangers support the grid from the 16-ft., 6½-in. ceiling.

To facilitate maintenance and lamp replacement, five 8-ft. sections of grid under each row of lamps have seven removable cross members (see diagonal lined sections, Fig. 1).

A six foot extension of the louvered ceiling forms an illuminated canopy over the sidewalk on the south side of the building. Here the fixtures are housed in a metal enclosure with hinged glass panels. Removable lateral members of the aluminum grid provide access to the units.

The area under the east balcony of the room is illuminated by four 40-watt surface type, fluorescent units (Smithcraft Louverlites). Flush type, deep louvered troffers—each with two 40-watt fluorescent lamps—illuminate the area above the balcony (see Fig. 2). Spacing varies from 6-ft. to 4-ft., 9-in. to obtain a resultant intensity equivalent to that of the main floor area.

TABLE I
RECORDED ILLUMINATION INTENSITIES*
TWA OFFICE—CHICAGO

Area Checked	Footcandle Intensity
On a horizontal plane in center of room	
At floor level	34
3 feet above floor	35
43 inches above floor (counter level)	35
14 feet above floor	41
Near windows	26
On a vertical plane in center of room (3 feet above floor)	23
On a plane 30 degrees to horizontal at counter level (man standing in working position)	23
Cut-off angles of louver ceiling	
Right angles to lamps—38½ degrees	
Parallel to lamps —20 degrees	

Note * Readings taken on Dec. 10, 1946, between 7:15 p.m. and 10:15 p.m., after lamps had been burning 2,000 hours.

Slimline tubes above the louvered ceiling extend to within six inches of the wall and plate glass window (north-south direction). No glare or "light spot" is noticeable on the wall. Although there is a reflection from the plate glass window (south wall), the reflected image is of less surface brightness than the fixtures and is not objectionable. Also, it gives the office an appearance of added size. Light colored walls and furnishings enhance the lighting.

Intensities listed in Table I, were recorded after 2,000 hours of service.

No. V-4714

No. V-4924 ceiling type

No. V-612—Sunburst design, clear crystal glass with bright chromium

No. V-4914

No. V-4724 ceiling type

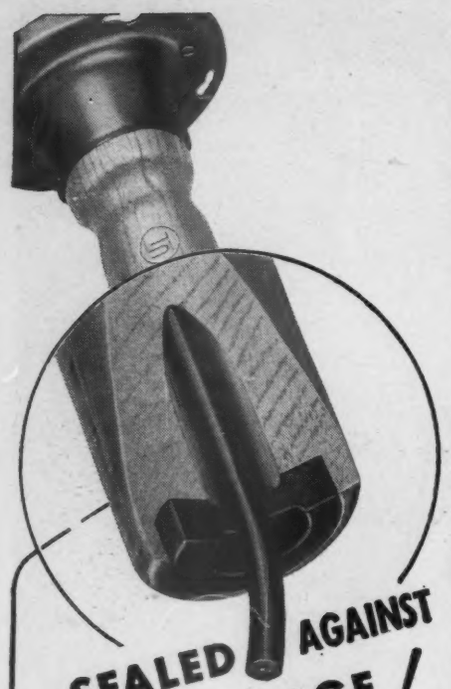
Four examples of French Crystal

AND ONE OF CLEAR GLASS *by Virden*

Rich with sparkling French crystal and gleaming chromium, these beautiful creations are an eloquent argument for fixtures by Virden. People have only to see them to want them. Because these units develop neither glare nor high surface brightness to offend or injure eyes, they represent both sound thinking and sound design. Prices attractive. See your Virden distributor.

John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute



SEALED AGAINST SEEPAGE!

McGILL LAMP GUARD HANDLES

No. 4675

No. 8000

A live red rubber gasket, solidly cemented into the end of the handle adds still another safety feature to all McGill wood-handle Lamp Guards. Flexible, yet firm, the rubber gasket grips the cord closely as it enters the handle. The snug fit makes a moisture-proof seal which positively bars dangerous water seepage . . . holds the cord away from the sides of the channel, preventing the cord-fray which means shorts and shocks. There are more than seventy portable wood-handle lamp guard types in the comprehensive McGill line . . . all of them designed for maximum safety. Other safety and convenience features include handy thumb switch, cage heavily plated to prevent corrosion, Levolier socket and sturdy hardwood handle. Write direct or ask your wholesaler for more information on "Safety-First" McGill Lamp Guards . . . for every lamp use in industry.

Electrical Division

McGILL

MANUFACTURING CO., INC.

VALPARAISO, INDIANA

50 Footcandles In Sales Office

Recent "light conditioning" of the first floor office of the Oklahoma Gas & Electric Company, Oklahoma City, provided an average maintained illumination intensity of approximately 50 footcandles throughout the 7,800 sq. ft. area.

To secure the desired quality and quantity of illumination, 148 four-lamp, 40-watt, Solar fluorescent luminaires were surface-mounted to the 16-ft., 6-in. ceiling. Fixture pattern consists of two three-unit sections in each of the bays formed by the massive beams and columns. Only eight fixtures are individually mounted.

Each luminaire accommodates four, 4500-degree white lamps and has an enclosure assembly consisting of bent ribbed diffusing glass side panels (ceramic treated on the inside to provide 30 percent light transmission) and hinged bottom louvers with a 45-degree shielding angle.

A flat white ceiling, warm pinkish tan mottled shiny marble columns and light dull-finish marble floor combine to boost lighting efficiency. With an approximate load of 3.62 watts per sq. ft., measured intensity after 200 hours of operation approximated 50 foot candles. Both employees and customers have expressed complete satisfaction with the new lighting system.

High-ceiling office area illuminated with surface-mounted fluorescent units. New 4500-degree white lamps provide approximately 50 footcandles with a 3.62 watt per sq. ft. load. Glass side panels have 30 percent light transmission value; bottom louvers, 45-degree shielding angle.

Display Spotlight

In department stores as well as in main street commercial shops, visible light sources can attract favorable comment from customers when attractively mounted and used to conform to a planned overall pattern. In Gimbel's Pittsburgh store a combination of fluorescent and incandescent illumination is employed to give general lighting and to accent feature display areas. Pictured is a shallow fashion display, lighted by an incandescent spotlight housed in a modernistic, spherical unit created by the Century Lighting Company. Rather than hide or disguise the source of this highlighting equipment, the modern atmosphere of the store is emphasized by the design of the visible lamp housing. General illumination is provided by standard 4-lamp 40 watt fluorescent flush mounted fixtures.

Incandescent spotlight, housed in modernistic ceiling mounted unit, highlights shallow feature display area. General illumination is furnished by flush mounted fluorescent fixtures.

Functional Beauty and Efficiency

When quality and appearance are deciding factors on a lighting job . . . your best choice is either the Curtis 70610XE or the Curtis StarLux.

Originally a special design, the 70610XE was created for one particular installation where the customer demanded quality and distinction and was willing to pay for it. Now, this unit is generally available. Modern production methods assure a reasonable price for such jobs as demand beauty, quality and efficiency. For four 40-watt fluorescent lamps per section.

The Curtis StarLux is the outstanding four-lamp pendant luminaire on the market. Like its companion The No. 70610XE, The StarLux is characterized by beauty and efficiency. Some of its output is directed toward the ceiling to create a pleasing and comfortable effect... some of the light is directed downward through the decorative louvers to add intensity below the unit, and the balance flows through the glass panels and diffuses into the room. Strictly a quality item, its price however, appeals to that important class of jobs which are just above the mass market. *Write today for Data Sheets on both of these attractive four-lamp luminaires.*

CURTIS
Lighting
INC.
6135 WEST 65th STREET
CHICAGO 38 • ILLINOIS

For Dependable Pilot Lights

P&S 1340 — small, compact, versatile — a combination device. Can be installed in multiples of two or three to a gang — or combined with one or two P&S-Despard switches or outlets in a single gang switch box.

Supplied with S-6, 6-Watt lamp and reflector. Rated 75 Watts, 125 Volts. Current consumption is negligible. For maximum safety at minimum operating cost, use P&S 1340.

Keep Your P&S Catalog Handy

PASS & SEYMOUR INC.
SYRACUSE 9, N. Y.

TYPE T CHARACTERISTICS

[FROM PAGE 57]

necessary for those manufacturers whose wire is approved for such uses to so inform the user by printing on the surface of the wire that the wire is oil-resistant. This is not being done by all manufacturers but it is thought that since the 1947 Code will require surface printing on Type T and TW wires, most manufacturers will include the "oil-resistant" marking so as to provide the user and inspector with information he must have.

In general, it is fair to state that the thermoplastic insulations are unusually resistant to acids and alkalies. The following tabulation of the performance of one manufacturer's compounds may give the user a somewhat clearer picture of conditions under which some Type T or TW wires can be used. In referring to this chart it must be understood that not all manufacturers' wires have the same degree of resistance to these elements.

It is of interest to note that contrary to some opinions the thermoplastic insulations show excellent resistance to abrasion. This has been demonstrated in many places by the armed forces under field conditions. But along with this excellent abrasion resistance goes rather poor cutting resistance. A sharp knife can easily shave the insulation from the wire. This characteristic has caused some difficulty where the electrician has forgotten to properly ream a conduit. More care must be exercised to see that all sharp edges are removed when Type T or TW wires are to be pulled than when Type R wires are used. The asphalt finishing compounds used on the Type R wires smear over the cutting edges and tend to resist further cutting of the insulation. However, the tough abrasion resistant thermoplastic insulation will give ample protection where reasonable care has been exercised to remove cutting edges.

The most satisfactory lubricants for pulling thermoplastic insulated wires into conduits are paraffin wax or the lower melting paraffins commonly referred to as scale wax. The smooth hard surface on these wires would normally lead to the belief that such wires should be very easy to pull, even without a lubricant. Unfortunately, however, the polyvinyl thermoplastics have a high coefficient of friction and difficulty has arisen where lubricants were not used. Some manufacturers have recognized this and have applied lubricants to the surface of the wire which provides comparable pulling characteristics of the best Type R.

Many electricians have learned of the great saving in time that is made possible by the vivid permanent colors which are obtainable in Type T and TW wires. Circuit identification can be readily maintained under the most severe conditions. There are also additional savings to be obtained through its use in rewiring.

CHEMICAL RESISTANCE PROPERTIES OF FLAMENOL TYPES T AND TW BUILDING WIRE

Reagents and Solvents	Reaction
Concentrated Sulphuric Acid	Hardens Insulation
30 Per Cent Sulphuric Acid	Nil
3 Per Cent Sulphuric Acid	Nil
Strong Alkalies (NaOH, KOH)	Nil
Glacial Acetic Acid	Slight Swelling and Hardening
25 Per Cent Acetic Acid	Nil
Concentrated Ammonium Hydroxide	Nil
Dilute Ammonium Hydroxide	Nil
95 Per Cent Ethyl Alcohol	Nil
50 Per Cent Ethyl Alcohol	Nil
Acetone	Swelling and Softening
Benzol	Slight Swelling and Softening
Xylene	Slight Swelling and Softening
Naptha	Slight Swelling and Softening
Gasoline	Nil
Kerosene	Nil
Paraffin Waxes	Nil
Mineral Oils	Nil
Chloroform	Slight Swelling
Methyl Ethyl Ketone	Dissolves
Amylacetate	Swelling
Carbon Tetrachloride	Slight Swelling

Note: Data for the above was obtained from tests conducted for 7 days at room temp.

Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters, Chief Inspector, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

Questions on the Code

Acoustical Ceiling

Q. *We have just finished the wiring of a new school building on which the specifications were changed to provide for acoustical treatment of the ceilings of part of the building. All outlet boxes were placed flush with the plaster finish and the acoustic board being 5/16 inches in thickness extends that distance beyond the box. The inspector refuses to O.K. the job as it is and the school board wants the O.K. before they will pay for the work. I cannot find any extension rings less than ½ inch deep and cannot afford to reset each box. What does the Code require?*—S.M.

A. You apparently have two questions, the first of which might best be directed elsewhere if the acoustic board treatment was not covered in the specifications on which your bid was made and accepted. The second question pertains to the Code and under Section 3711 you will note that if the acoustical tile or board is combustible, the outlet boxes shall be flush with the finished surface or extend beyond, so the half inch extension ring would comply with the Code even though it did extend 3/16 of an inch beyond the surface of the board. —G.R.

Type R Wire

Q. *I have just received my copy of the 1947 Code and find that a No. 6 type R wire is rated at 55 amperes in conduit. Now the 1940 Code rated this wire at 45 amperes and the 1937 Code showed 50 amperes. What is the reason for these changes?*—*E.K.W.*

A. The 1940 edition of the Code reduced the carrying capacity of type R conductors from 50 to 45 amperes, for not more than three conductors within conduit, following a series of exhaustive tests conducted by NEMA which indicated this and other changes in the current carrying capacities of copper conductor were in order. Because the Electrical Code Committee followed this report in the preparation of Table No. 1 of the 1940 Code, we had a most complicated table of current carrying capacities that proved rather unwieldy. Therefore when the Code Committee began the preparation of the 1947 Code, they saw fit to suggest a change in the construction of type R insulation. This change was accepted by the industry so new type R conductors actually bear a different insulation, in fact they are now rated at 60°C instead of 50°C and have similar carrying capacities with type T, TW, RU and RW.

This change brings about a condition that both contractors and inspectors must watch until the stock of old type R insulated conductor is exhausted. Due to existing conditions, this period will not be long but during the interim, old type R wire must not be used to carry more amperage than was permitted by the 1940 Code.—F.N.M.S.

Farm Wiring

Q. *We are wiring a number of farms and on many of them the owners have separate buildings used only for laundry and change house purposes. In most cases these buildings are located fairly close to the requirement covering appliance circuits in dwellings. Is it necessary to have an appliance circuit within these buildings? As they are all small and never require more than two light outlets, we would prefer to use only a single circuit within them.*—L.M.

A. The Code, of course, does not contemplate a separate laundry building and therefore the requirement found under Section 2109 does not apply. Occupancy conditions of these laundry and change houses should determine the type and number of circuits necessary. However, in view of the fact that there is a possibility of the addition of a number of current consuming appliances, such as electric water heaters, mangles, etc., in addition to the quarter horsepower driven washing machine, I believe it advisable to install either service or feeders of sufficient capacity to these buildings to assure proper voltage for such equipment, even though only a single 15 ampere circuit is all that is needed at present.—G.R.

Dishwashers Not Generally Portable

Q. *A dishwasher in a residence was connected to a receptacle on a separate No. 14 branch circuit. Is this permissible? If not, would it be permissible if the receptacle were removed and the dishwasher leads connected permanently to the circuit conductors?*—R.F.

A. The first way mentioned would be a violation of the Code in two ways even though a No. 12 wire circuit was installed for appliances and this was a separate circuit.

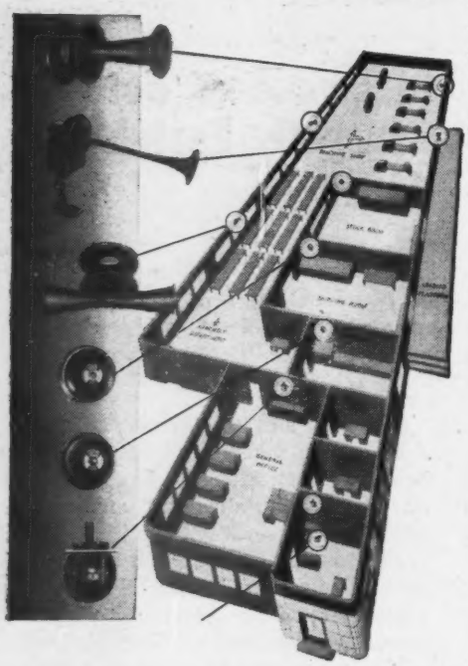
The first violation is that inasmuch as a dishwasher is generally not a portable appliance because it is permanently connected to both hot and cold water supply and to sewage drains, it should not be connected to a receptacle but should be connected up in a permanent manner.

In the May 1946 Underwriters Laboratories' List of the 30 motor driven washing machines, 29 are listed as "Portable, motor driven washing machines" and only one as "Motor driven Washing Machine". The latter listing indicates that they are not portable and must not be connected up as such.

The second violation would be the installation of an appliance branch circuit of No. 14 wire feeding a receptacle, or receptacles, in a kitchen. The 1940 Code states that in dwellings,

FARADAY KODEMASTER

Gets the right man in a jiffy!



A long distance call—an important conference—can't wait for the operator to telephone all around the plant. Time is valuable—too expensive to waste! Kodemaster will get the right man in a jiffy—only a few seconds and its message reaches every nook and corner of the plant and the man is located.

Every factory large enough for a telephone switchboard needs the efficient Faraday Kodemaster. It's the ideal system for locating individuals in a hurry—up to 30 different code signals.

Kodemaster is a unique, compact, fool-proof control for *old* or *new* signal systems. May be set up with any number or combination of bells, buzzers, horns, Kodaires, chimes, sirens.

For profits now and customer satisfaction that will lead to more business later, recommend and install Faraday Kodemaster.

FARADAY UNIPACT units are interchangeable, "as easy as plugging in a toaster."

FARADAY
ELECTRIC CORPORATION
Adrian, Michigan

branch circuits supplying receptacle outlets in kitchens shall not supply other than receptacle outlets and that "such circuits shall have conductors not smaller than No. 12. Note the plural word *"circuits"*.

This intent quite clearly is that all circuits supplying receptacle outlets in the rooms mentioned in Section 2109 must be of No. 12 wires. This is still more clearly stated in the 1947 Code in sub-paragraph b of Section 2115 which states that one or more branch circuits shall be provided for *all* receptacle outlets (other than clocks) and that the conductors shall not be smaller than No. 12.

Now for the answer to the second part of the question: Yes, it would be permissible (and proper) to connect the dishwasher permanently to a branch circuit installed separately for that purpose. This, being a motor branch circuit supplying a motor with a rating of less than 12 amps., could be a No. 14 wire circuit. As the three dishwashers listed by Underwriters' Laboratories, are rated ⅓ or ¼ hp. or less, the rating of the motor would be less than 6 amps.—F.N.M.S.

Multi-Wire Circuit

Q. *We have just been called for the use of a common neutral with four 15 ampere circuits by the inspector even though the neutral is sufficiently large to safely carry the maximum load which might be placed on it. Does the Underwriters' Code permit this?*—S.R.

A. The multi-wire branch circuit may only be used when a potential difference exists between all ungrounded conductors of the circuit. Therefore if the service is 4 wire 3 phase one might use a 4 conductor 3 circuit multi-wire circuit. This ruling may be found under Section 2104 of the Code and is not changed in the 1947 edition.—G.R.

Motor Group

Q. *I am laying out the wiring for several groups of motors and would like to have a clearer interpretation of paragraphs 4349 and 2434c. The following are the conditions involved:*

One group consists of two 3 hp. and one 5 hp. motors, 400 volt, 3 phase 60

Super Light for a Super Mart!

by... MITCHELL

Model No. 3011
DELUXE LOUVERED LUMINAIRE

BEFORE—
The Food City Market, huge Supermart in Pittsburgh, Pa., as it appeared before re-lighting. Average overall illumination, only 5 foot-candles by actual measurement.

AFTER—
Here's the same Food City Market, "sales-activated" by MITCHELL Fluorescent Lighting. 85 foot-candles average maintained! Achieved by MITCHELL DeLuxe Louvered Luminaires No. 3011 and No. 3009 in continuous row mount.

Two different stores? No—it's the same place—but the attractive, sales-inviting establishment pictured at the right was created by a MITCHELL Fluorescent Lighting installation that changed the average foot-candle reading from only 5 to a full 85! Every bit of this new abundant high-level illumination provides glareless, even light over the entire store area—superior light that creates a "selling" atmosphere.

Customers now find the products they want quickly and easily—they *buy more* because they *see more* to buy. Salespeople work with less strain and fewer errors—for bigger sales and profits. Here is "sales-engineered" lighting by MITCHELL—from every angle, the Better Light for Better Business . . .

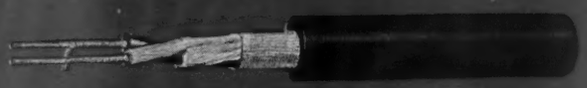
Installations like these build tremendous user acceptance for MITCHELL Lighting—mean better business for the wholesaler. MITCHELL sales are package transactions—trouble-free volume business. MITCHELL installations are easy, smooth jobs for the contractor—time-saving, profitable business...

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

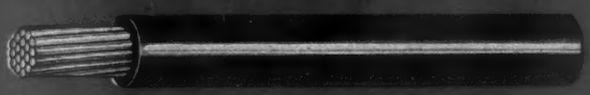
MITCHELL *Better Light for Better Business*

Makers of Commercial and Industrial Fluorescent Lighting Equipment
Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties . . . Rad-i-Air Germicidal Units (made by Tru-Air Ultraviolet Products Co., Los Angeles)

CRESCENT
Makes A Complete Line Of
ELECTRICAL WIRES & CABLES

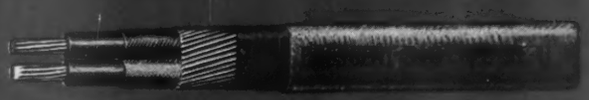


CRESCORD . Jacketed Portable Cord



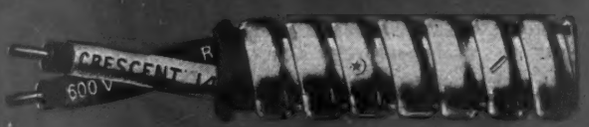
SYNTHOL Building Wire - Types T & TW

Rubber Covered Building Wire and Cable



Service Cable - Types SE-U; SE-A; SD

CRESFLEX Non-Metallic Sheathed Cable



A B C Armored Cable

AND AMONG OTHER TYPES THE FOLLOWING:

Bare Copper Wire & Cable
Brewery Cord
Control Cables
Fire Alarm Cable
Fixture Wires
Flexible Cords
Flexible Steel Conduit
Heater Cord
Neoprene Jacketed Portable Cable
PERMACORD
Power Cables
Shipboard Cable
Signal Cable
Slow burning Wire & Cable
Switchboard Wire & Cable
Telephone Wire & Cable
Thermostat Cable
Trench Cable
Varnished Cambric Cable
Weatherproof Wire & Cable
Welding Cable

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TRENTON, N. J.

cycles. The controls are combination switches and magnetic contactors. The feeder consists of 3-750,000 CM. V.C. located about 10 or 12 feet away from the contactor group under the floor.

Is it permissible to apply Rule 4349 and also 2434c to the same tap sub-feeder? Namely could I reduce to 1/3 capacity which is No. 00 V.C. run this to a junction box within 5 feet of the contactor group and then apply Rule 2434c and tap on smaller wires to the No. 00, so they can be brought into these contactors properly? Or is it required to bring the 750,000 CM. into the junction box and then tap on the small size wires?—L.D.C..

A. To apply Rule 2434c it would be necessary to terminate the No. 00 wires in a circuit breaker or set of fuses to limit the load to the capacity of the No. 00. If that is done, then the wires from this cutout box (instead of junction box) to the contactor group, could be 1/3 the capacity of the cutout rating, and again would have to terminate in protective devices to afford proper protection to these wires.

In other words, No. 00 wire could be tapped to the 750,000 CM. wires, terminating in 175 amp. fuses, then No. 6 V.C. wire could be run from this 175 amp. fuse to the contactor group to pick up the first group of motors. This above method is rather complicated and unnecessary.

Probably the better way to do would be to tap wires of sufficient size to carry the group of motors to the feeder and to place a cutout at this point. The size of these tap wires for 2-3 hp. and 1-5 hp. 440 volt 3 phase motors would be No. 14 V.C. The cutout would be rated at not over 30 amperes to comply with Section 4362. From this cutout No. 14 would run to the contactor group.—F.N.M.S.

Aluminum Wire

Q. *The inspector has refused to OK the wiring installation we have just finished in a dairy barn because we used aluminum wire with copper connectors. Does the Code forbid such practice?—M.R.*

A. The N. E. Code Committee never expected that copper conductors would not be available or they would certainly have provided definite rules pertaining to the use of aluminum. Reference to section 3462 will substantiate the previous statement as you will find that the use of dissimilar metals in raceway systems subject to cor-

More *Silent* than a speck of Dirt

Quiet-Room Tests Put R & M Motors on R. C. A. Recording Machines

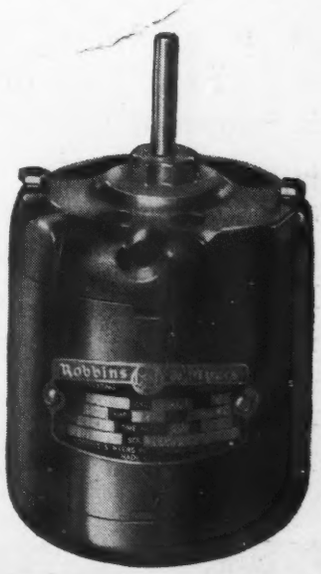
How *silent* can a motor be? R.C.A. engineers found out. In exacting tests of leading makes, Robbins & Myers hysteresis motors proved themselves the *quietest* of all.

These motors operate so *noiselessly* that were a grain of dirt to find its way into one of the bearings, the rattle of this *minute* particle rolling around would be heard above the motor.

It's no wonder that R & M hysteresis-type synchronous motors now power all R.C.A. *ultra-quiet* recording machines. There's no hum to cause objectionable undertones; no *vibration.* Smooth torque is transmitted to rim of plate through a soft rubber pulley.

Specialized *performance* like this has well earned the Robbins & Myers reputation for meeting unusual motor needs. It's one of the reasons why you're finding more and more R & M's on all types of motor-driven equipment.

THIS HYSTERESIS-TYPE R&M SYNCHRONOUS MOTOR OPERATES R. C. A. SUPER-QUIET RECORDERS



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In Canada: Robbins & Myers Co., of Canada, Ltd., Brantford, Ont.

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THIS IS A TIME FOR DECISION!

Synthetic or Natural?

Every once in a while a basic decision must be made by every growing industry. The wire and cable industry must make such a decision now. Natural rubber is becoming more plentiful. Is it to resume its former important place in wire and cable insulations? Have synthetic rubber insulations made a place for themselves? How do they compare with those made with natural rubber?

We have attempted to answer these questions in a new "Report to Industry." Available data show that most wires and cables are better with synthetic rubber insulations. We are well pleased with synthetic rubber. Our experience with synthetic rubber during recent years has persuaded us that we can best serve you by using it in the future.

Every user of insulated wires and cables is interested in this subject. If you have not already received a copy of our report, we suggest that you ask for "Our Third Report to Industry on Synthetic Rubber Insulations." In it we have explained our reasons for deciding in favor of synthetic rubber and have included comparative data showing the present relative values of natural and synthetic rubber insulations.

Simplex-WIRES & CABLES

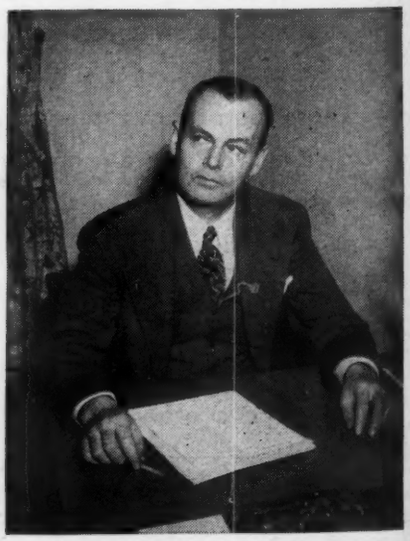
SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

rosive atmosphere is prohibited. So even though the Code does not definitely prohibit the use of copper or bronze connectors on aluminum conductors where subject to corrosive conditions, the fact that galvanic action will soon destroy the electrical conductivity of the joint and in time the joint itself, should be sufficient reason for good electrical inspectors to forbid such installations.—G.R.

Grounding

Q. *We are wiring a number of new homes located in a suburban area. It has always been our practice to ground the bathroom fixtures to the cold water pipe in the bathroom, but inasmuch as these houses are equipped with individual water systems, we understand that this method of grounding must be stopped. What is the Code ruling on this?*—R.O.

A. The National Electrical Code now contains a new section No. 2554 which answers your question. This section is as follows: "Where the alternating current system is connected to a grounding electrode in or at a building as specified in sections 2523 and 2524, the same electrode shall be used to ground wire enclosures and equipment in or on that building." In your particular case you could still ground the bathroom fixtures to the cold water pipe provided the water pipe is electrically connected to the same electrode used to ground the neutral conductor. Permission to do this will be found under section 2591-b. —G.R.



Guiding the activities of the Cincinnati Electrical Association is business manager E. J. McGinnis who took over when Gene Zachman resigned. Mr. McGinnis was formerly with the General Motors Acceptance Corporation.

In the News

Single-Phase Rural Service Advocated

Discussions of equipment design, electrical service, rate structures and the economics of electrification embodied a good portion of the program at the December conference of the American Society of Agricultural Engineers held at Chicago's Stevens Hotel.

Consensus of those assembled—agricultural, utility, engineering and manufacturers' representatives—was that single phase service will be adequate for most all farm requirements; that three-phase is not economical; that a 7½ hp. motor will take care of the heaviest farm load. These views were aired by Lee Moore, REA, who discussed rural power line distribution design and A. H. Hemker, rural electrification engineer, General Electric Company.

Mr. Moore cautioned that the uncertainty of rural service might be a contributory factor to the apparent delay in full rural electrification and suggested a thorough study be made of continuity of service. He cited the oil circuit recloser as an outstanding example of new developments in rural electric service.

Reviewing numerous farm equipment applications, Mr. Hemker pointed out that three-phase motors with their necessary starting equipment are more expensive than the single-phase units which he believes will answer the farmer's needs. Ensuing floor discussions emphasized the economic necessity of adhering to single-phase and questioned the need for more than a 5 hp. motor on any farm.

There is a definite trend toward higher demands and lower load factors in rural areas, stated A. E. Anderson, Commonwealth & Southern Corporation, while discussing rate structures. To substantiate this observation, he revealed the results of a 500-customer survey which showed a variance from 19.4 percent annual load factor at 6 kw. demand to 14.1 percent at 11 kilowatt demand.

Evidence that farm electrification pays dividends was presented by B. G. Perkins of the Doane Agricultural Service. Presenting a cost analysis made on a test farm in eastern Ohio, Mr. Perkins revealed that electrification, with an equipment investment of $535, reduced farm work by 535 man-hours in one year. Annual operating cost, including depreciation and energy cost, was $103. Earnings on this farm during the year amounted to 69 cents per man-hour of work. Rate of return on the electrical investment, Mr. Perkins concluded, was 49.6 percent.

Another trend on the modern farm is the application of forced ventilation for dairy and poultry houses. This was revealed in a joint paper by Truman E. Heinton and J. R. McCalmont of the U. S. Department of Agriculture. Control of temperature and humidity have a definite effect on production in these categories and since electric ventilation is somewhat new, further research was advocated to secure more accurate data.

This conference, as has other farm electrification sessions in the past, leaves no doubt that utilization of electrical energy in rural areas is now being considered from a productive angle, in the same manner as that formerly employed in the industrial field.

Chicago Groups Elect Officers

Incumbents were re-elected to a majority of executive positions in two of Chicago's electrical groups—the Electric Motor and Service Association and Cook County Electrical Contractor's Association.

The following are the 1947 slates for the two associations:

E. M. S. A. — President — R. C. Kaska, Chicago Electric Co.; vice-president—J. G. Lessel, Central Motor & Repair Co.; secretary—H. P. Lehman, Lehman Electric Co.; treasurer (new)—A. J. Jefferies, Bowers & Clark. Incumbent directors chosen for another one year term are: Garrett Lea, Lea Electrical Equipment Co.; E. J. Ther, Ther Electric and Machine Company. For two year terms: P. M. Sievert, Sievert Electric Co., and Arthur Wagner, Sr., Arthur Wagner Company. Other board members include C. B. Kaska, P. J. Maher and Paul Martin.

C. C. E. C. A.—President—Emil DeHaan, Service Electric Shop; vice-

"Call that electrical contractor, dear, and explain to him that something has gone wrong with the automatic garage door"

WHEN YOU MEET A

Monarch Fuse

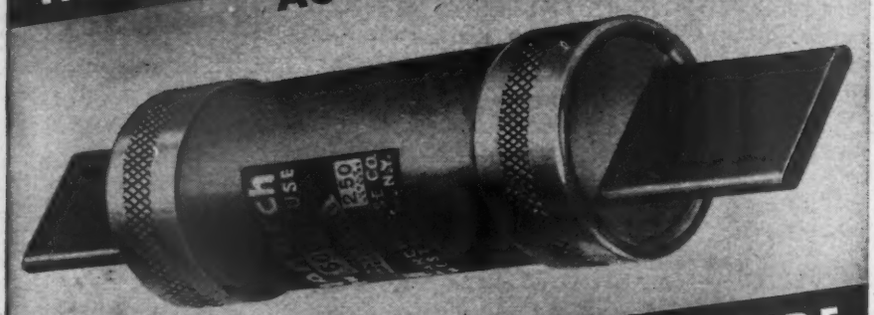
FACE TO FACE....

You are Impressed with the Amount of

BRASS

INSIDE

AS WELL AS...



OUTSIDE

Monarch *Renewable* Fuses

are famous for

BETTER HEAT DISSIPATION

and

EXTRA LONG SERVICE

AVAILABLE THROUGH RECOGNIZED WHOLESALERS

MONARCH FUSE CO., LTD.

118 E. FIRST ST. JAMESTOWN, N. Y.

president—George W. Reinke, Geo. W. Reinke Electric Co.; secretary (new) —Leo W. Witz, Continental Electrical Construction Co.; treasurer (new)—Joseph Turek, Avers Electric Co., (Berwyn). On the board of directors are J. M. Braverman, Gerson Electric Construction Co.; P. J. Falson, Falson Electric Co.; Victor G. Jensen, Jr., Jensen Electric Co.; and incumbents Roy Clausen, Westown Electric Co., (Cicero); Erwin Kaufmann, Kaufmann Electric Co.; Abe Sluis, Sluis Electric Co.; and Howard Zingraf, Square Z Electrical Company.

St. Louis Strike Settled

Approximately 700 electrical workers, whose work stoppage halted outside electrical construction activities of 33 St. Louis contractors, returned to work following agreement by the firms to pay $2.25 an hour instead of $2.

Failure of the electricians, members of the A.F.L. International Brotherhood of Electrical Workers, Local 1, to report for work came when the contractors, members of the National Electrical Contractors Association chapter, declined to grant the $2.25 rate which the union had negotiated with 72 other contracting firms.

Leo Hennessey, secretary of the I.B.E.W. local, said an agreement also was reached to extend the termination date of the contract to August 1, 1948, from the previous date of August 1, 1947.

Omvedt Joins Minnesota Council

Jack N. Omvedt, Minneapolis, was recently appointed assistant manager of the Minnesota Electrical Council (contractors-dealers in North Central area) by action of the Board of Directors. He will relieve Bill Ritt, present secretary-manager, of much of the load he now shoulders as manager of three expanding electrical associations in Minnesota.

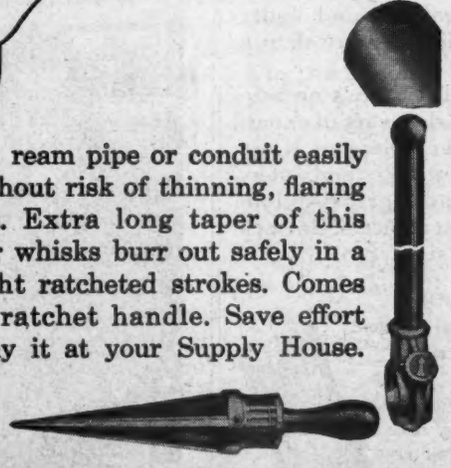
A law graduate of the University of Minnesota and George Washington University, Washington, D. C., Mr. Omvedt's career embodies the practice of law, four years with the U. S. Internal Revenue Department and Wage and Hour Division of the U. S. Department of Labor, work in the legal department of the Northwest airlines

Fast, safe LONG TAPER PIPE REAMING

RIDGID

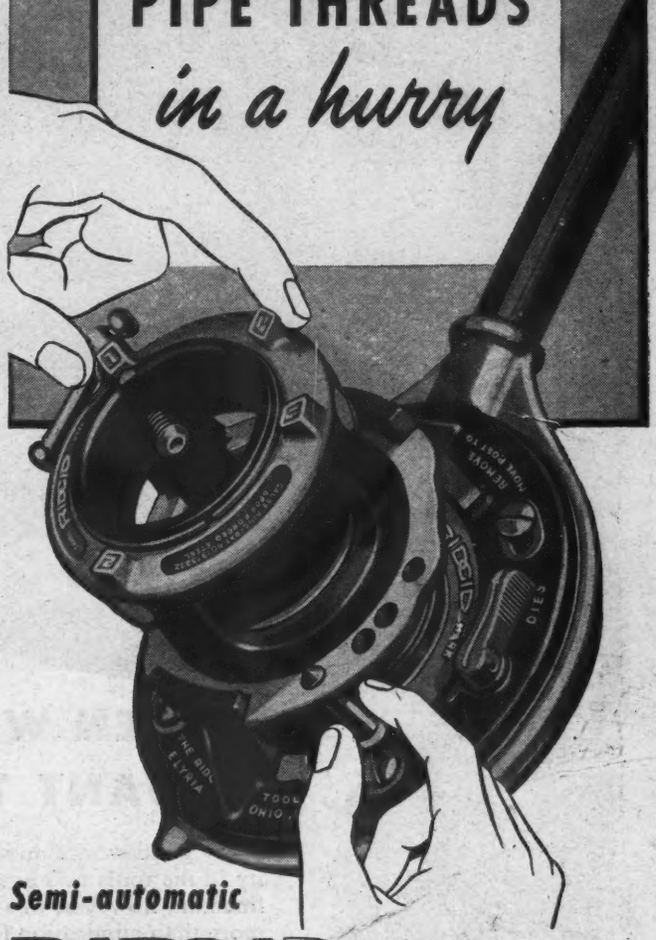
Extra-long-taper reamer saves you time, work ...and pipe

● Now you can ream pipe or conduit easily and quickly without risk of thinning, flaring or splitting it. Extra long taper of this RIDGID Reamer whisks burr out safely in a few feather-light ratcheted strokes. Comes complete with ratchet handle. Save effort (and pipe) — buy it at your Supply House.



Reamer unit fits RIDGID No. 00R Ratchet Threader Handle, also.

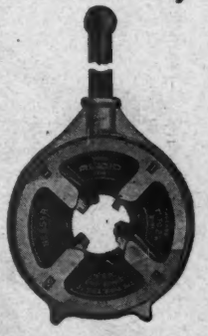
PERFECT PIPE THREADS *in a hurry*



Semi-automatic

RIDGID ***No. 65R is ready to thread 1″ to 2″ pipe almost instantly***

● When you have a self-contained No. 65R, there's no fooling around to thread 1", 1¼", 1½" or 2" pipe. Its one set of high-speed steel dies adjust to pipe size easily in 10 seconds. Mistake-proof workholder sets instantly — one screw to tighten, no bushings. Perfect threads quickly, with least effort. Every tool factory tested. More for your money — ask your Supply House for the No. 65R.



It stands up handily on the floor.

RIDGID **WORK-SAVER PIPE TOOLS**

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

KLEINS
FOR MEN WHO
WANT THE BEST
Every good workman appreciates high quality in the tools and equipment he uses. To a lineman, however, this regard for quality is more than admiration for fine craftsmanship. The lineman daily trusts his very life to his safety strap, belt and climbers—and under such conditions high quality is more than a matter of pride.
Good workmen know that there's no substitute for experience. It is the years of expert craftsmanship back of every piece of Klein equipment that make Klein belts and safety straps—Klein climbers and grips—Klein pliers and wrenches the first choice of linemen today as they have been "since 1857."
ASK YOUR SUPPLIER
Foreign Distributor: International Standard Electric Corp., New York
This book on the care and safe use of tools will be sent on request.
Since 1857
TOOLS
KLEIN
Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO

and service in the Navy during World War II. He will devote his entire time to Council affairs serving the needs of the greatly expanded membership which now totals 470, the highest in 14 years of Council existence.

Non-Housing Construction

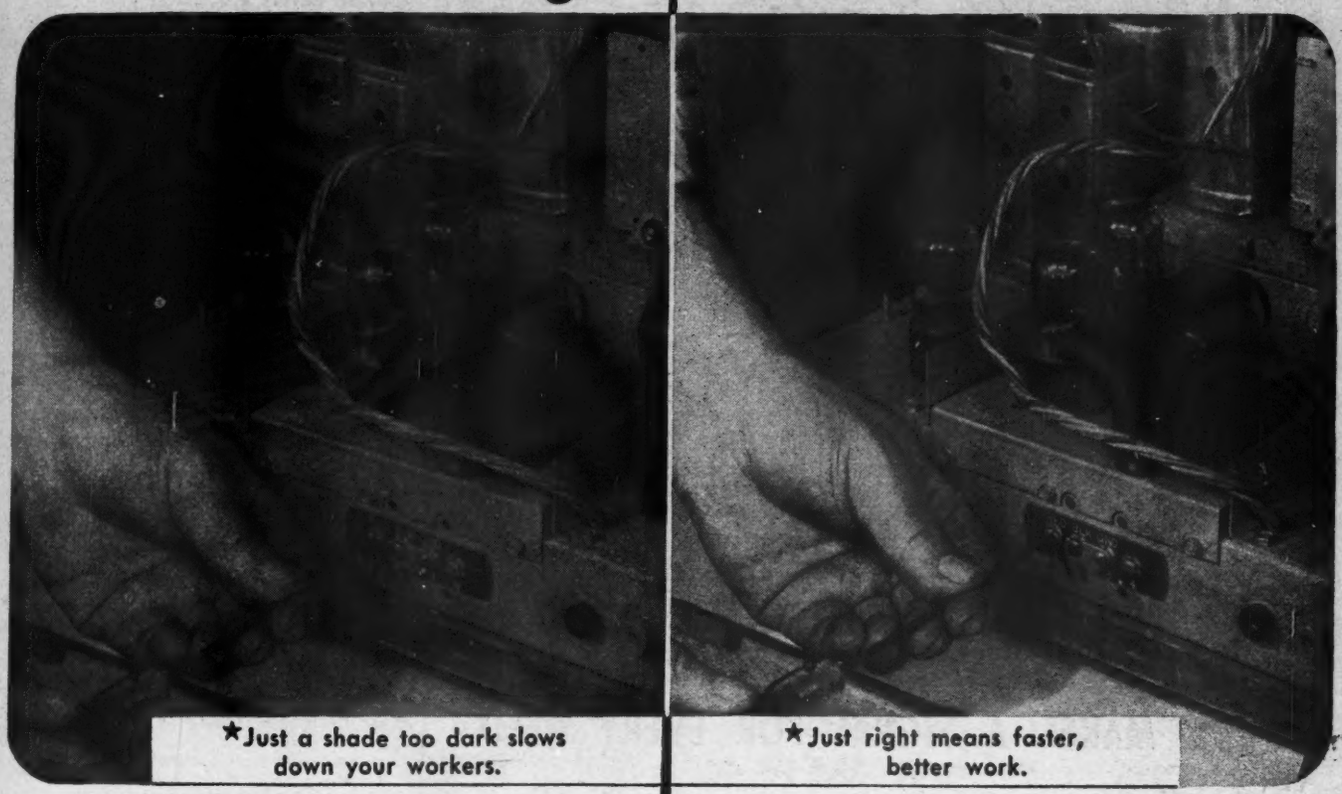
Applications for industrial, commercial, and institutional construction approved and denied by regions, from March 26, 1946 through January 16 were:

Region	*Approved Cost of Construction*	*Denied Cost of Construction*
(Cost of Construction in Thousands of Dollars)		
1–Boston	$ 154,391	$ 44,461
2–New York...	354,304	279,631
3–Cleveland ...	237,783	167,806
4–Atlanta	214,463	132,729
5–Chicago	210,179	184,854
6–Kansas City.	156,292	69,208
7–Dallas	194,429	91,520
8–Los Angeles.	178,812	137,070
9–San Francisco	207,998	142,556
10—Minneapolis	52,335	29,701
11–San Juan, PR	5,597	5,509
Field Total .	$1,957,583	$1,285,045
Facilities Review Committee	$ 591,196	$ 631,351
U. S. Total..	$2,548,779	$1,916,396

F. G. Bachman, vice president in charge of production at the Everson Electric Company, Allentown, Pennsylvania, selects a step-wound coil form from among the 1200 winding units constructed at and stored in the Everson shop.

BORDERLINE VISION*

"Chiseling" Your Profits?



★Just a shade too dark slows down your workers.

★Just right means faster, better work.

Lower Production Costs With Wheeler Skilled Lighting!

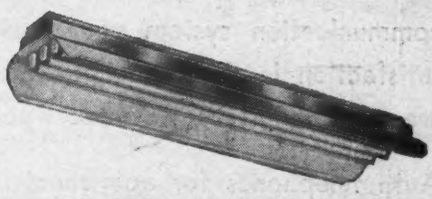
You may not realize you're being "chiseled". Lighting that's just a shade too dim may be hard to spot at a glance. But...

Borderline Vision in many a plant cuts into profits because of little, individual production slow-downs. A careful worker may take a second look. A careless one may make a mistake that means rejects . . . little slow-downs that add up to an expensive lag in production.

Since 1881 Wheeler engineers have specialized in eliminating these lighting handicaps. Wheeler Reflectors are engineered to control light – to put light to work where it's needed – on the job. Their special, high reflection factor gets maximum illumination from standard lamps. And their rugged, porcelain-enamel coated construction means long service and minimum maintenance.

Learn why better work and reduced costs are almost automatic when you install Wheeler Skilled Lighting. Write today for full details on Wheeler incandescent and fluorescent lighting fixtures. **Wheeler Reflector Co., 275 Congress St., Boston 10, Mass.** Representatives in New York and principal cities.

Distributed Exclusively Through Electrical Wholesalers



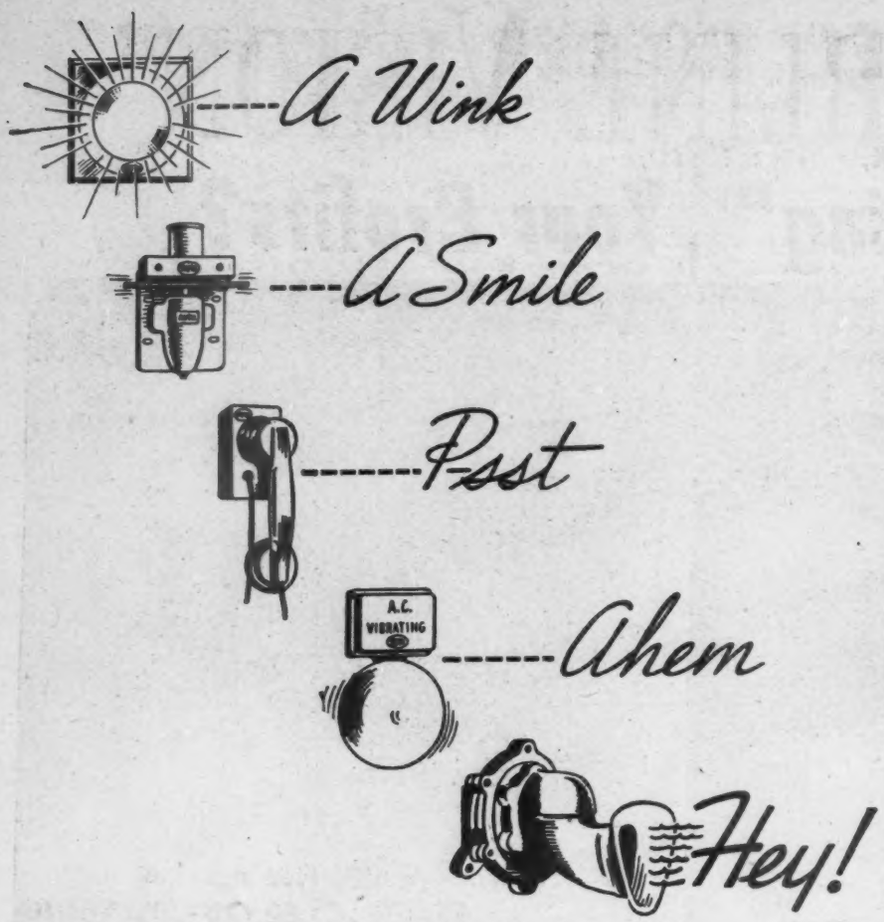
All-Steel Open-End Fluorescent Unit
Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.

RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

Wheeler Reflectors
SKILLED LIGHTING

MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881



AUTH MAKES A SIGNAL FOR EVERY NEED

It doesn't make any difference what kind of a signal or intercommunication system your customer wants, he'll find greater satisfaction in Auth equipment. And you'll find Auth devices are easier to install, electrically age-proof, and mechanically durable.

Auth telephones for apartments, offices, plants and commercial buildings include non-selective and selective talking systems — thoroughly modern in appearance and efficiency.

There's an Auth bell, buzzer, horn, push-button, chime or visual signal that's just right for every application and every condition. Hospital, school, and marine signal systems are Auth specialties. Also fire alarms, burglar alarms, and countless other signaling devices.

Specify or recommend Auth and put 50 years of experience into the job. The Auth representative near you will be glad to help.

1-8

AUTH ELECTRIC COMPANY, INC.
34-20 45th STREET LONG ISLAND CITY 1, N. Y.
Offices in Principal Cities
SINCE 1892

Chattanooga Group Elects

Robert F. Shedd, Westinghouse Electric Corp., Chattanooga, Tenn., was elected president of the Electric League of Chattanooga at its October meeting. Assisting him as members of the official family are: First vice-president—Frank Grant, Modern Home Appliances; second vice-president—L. A. Ragon, Ragon Electric Company (contractor); secretary—Paul J. McMillan, Electric Power Board; and treasurer—C. C. Bower, Tri-State Supply Company.

Argo Heads Tennessee NISA

M. M. Argo, Birmingham Electric & Mfg. Co., Birmingham, Ala., was elected president of the Tennessee Chapter, NISA, at a recent meeting of that group. Chosen to sit with him in the official family circle were: Vice-president—M. G. Miller, Tennessee Electric Motor Service, Nashville; secretary-treasurer—O. B. French, Southern Carbon Brush Co., Birmingham. Directors are: W. J. Howard, Standard Electric Machine Co., Montgomery, Ala.; and Ellis M. Fagan, Fagan Electric Co., Inc., Little Rock, Ark.

DATES AHEAD

National Electric Sign Association—Convention and equipment exhibit, Congress Hotel, Chicago, Ill., February 3-5.
Indiana Chapter, I.A.E.I.—Indianapolis, Indiana, Feb. 6-7.
National Association of Home Builders—Convention and exhibit, Stevens Hotel, Chicago, Ill., February 23-27.
Adequate Wiring Forum—Sponsored by National Adequate Wiring Bureau, Hotel Stevens, Chicago, Ill., February 27-28.
National Electrical Manufacturers Association—Edgewater Beach Hotel, Chicago, Ill., Week of March 2.
Chicago Production Conference—Sponsored by Chicago Technical Societies, Hotel Stevens, Chicago, Ill., March 17-19.
North Central Electrical Industries—All-Industry Convention, Hotel Duluth, Duluth, Minn., March 17-19.
National Industrial Service Association—Annual Convention, Hotel Statler, Detroit, Mich., March 31, April 1-2.
Midwest Power Conference — Palmer House, Chicago, Ill., March 31, April 1-2.
National Association of Corrosion Engineers — Annual Convention, Palmer House, Chicago, Ill., April 7-10.
Home Builders Council of N. Y., N. J. and Connecticut—A Metropolitan Home Show, Grand Central Palace, New York, N. Y., April 19-27.
National Electrical Wholesalers Association—Annual Meeting, Hotel Traymore, Atlantic City, N. J.; May 4-9.
National Plastics Exposition—Stevens Hotel, Chicago, Ill., May 5-11.
National Electrical Manufacturers Association—Special section meetings, The Homestead, Hot Springs, Va., June 22-26.
National Electrical Contractors Association—Annual meeting, San Francisco, Calif., September 8-10.
2nd International Lighting Exposition—Hotel Stevens, Chicago, Ill., November 3-7.

AUSTIN REEL ROLLER

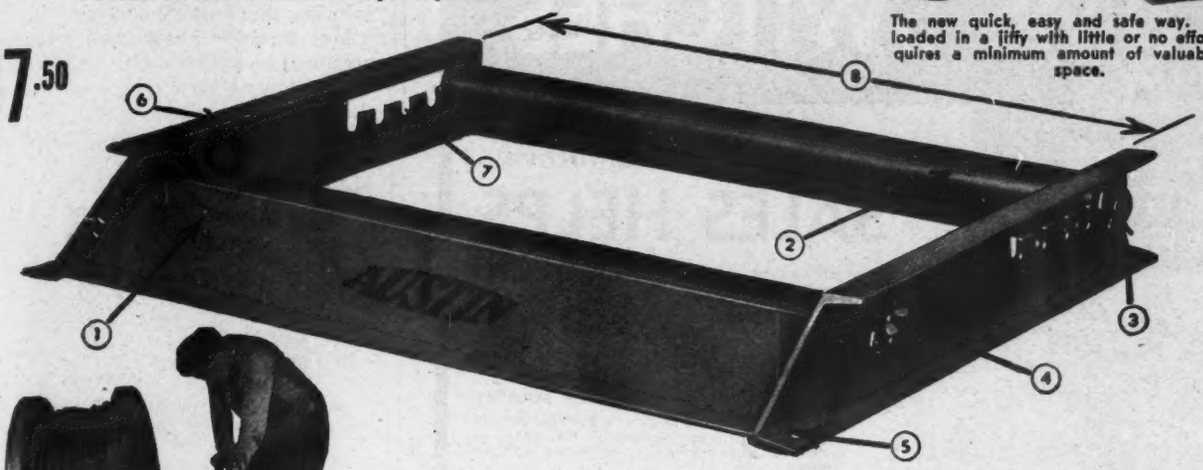
(Patent Pending)

NEW, SIMPLE, QUICK, SAFE METHOD

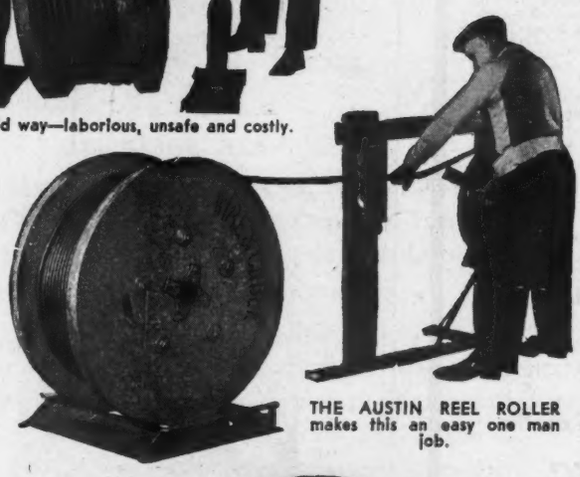
The AUSTIN Reel Roller dispenses any material that is wound on a reel and every Electrical Contractor, Utility, REA Co-operative, Shipyard, Railroad, and Wholesaler needs them. Mounted stationary or can be used on job as a portable device—ideal for pulling one or more cables into conduit and for service and repair trucks. A most economical investment . . . No. 600 REEL ROLLER at $37.50 each. *Prompt Shipment.*

The new quick, easy and safe way. Reel is loaded in a jiffy with little or no effort. Requires a minimum amount of valuable floor space.

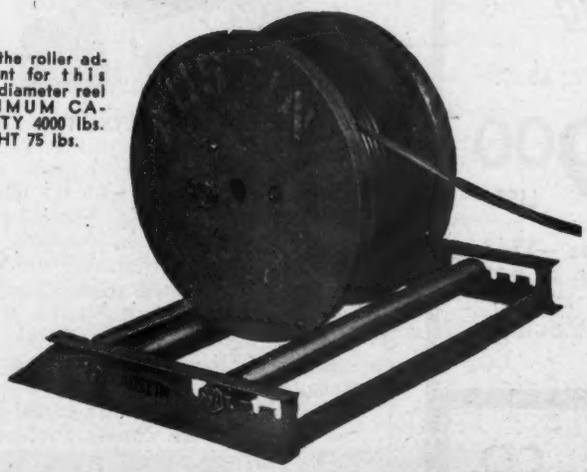
$37.50



The old way—laborious, unsafe and costly.



THE AUSTIN REEL ROLLER makes this an easy one man job.



Note the roller adjustment for this small diameter reel MAXIMUM CAPACITY 4000 lbs. WEIGHT 75 lbs.

POINTS THAT MAKE THE AUSTIN REEL ROLLER OUTSTANDING

(1) Ramp—Makes it quick and easy to load the reel onto the rollers.

(2) Back roller is mounted slightly higher, preventing the reel from being pulled off the roller when cable is removed.

(3) Reel rolls on grease packed flanged ball bearings with the greatest of ease and safety.

(4) Thumb screw, which when tightened, prevents roller from turning for easy removal of reel.

(5) Hole for lag screw, one in each corner for stationary mounting.

(6) Heavy steel frame, painted bright orange, not only adds to its appearance, but, also makes it readily visible on the floor which helps to eliminate accidents.

(7) Five adjustable slots to accommodate various reel diameters. No screws, washers or cotter pins to remove—simply raise up the roller and slide into the slot required.

(8) Will take any size reel up to 30" in width. For larger reels, use two reel rollers and mount end to end.

(9) Can be used in the warehouse or on the job.

• **ALL AUSTIN Products are sold thru the Electrical Wholesaler exclusively . . .**

Send him your order.

THE M. B. AUSTIN CO. 108-116 S. DESPLAINES STREET CHICAGO 6, ILLINOIS

Mr. Contractor:

IT'S EASY TO SELL

INTER-MATIC

TIME SWITCHES

by using these attractive

SALES HELPS

—which can be used as self mailers and envelope stuffers for distribution to all classes of prospects. They are designed to make sales and include order blank and space for name and address.

- **GET MORE PROFIT FROM YOUR POULTRY**
  This bulletin tells the poultry farmer the story of "Summer egg yield" all through the winter by means of automatically controlled artificial lighting.
- **AFTER SUNDOWN LIGHTING**
  This attractive circular shows merchants how to increase sales by lighting show windows and signs during the evening window-shopping hours.
- **APARTMENT HOUSE LIGHTING**
  This powerful sales message in the form of an insurance policy sells the apartment building owner on the need and saving of automatic light control for lobby, hall, stairway and yard lighting.
- **POLICE WITH LIGHT**
  This folder is directed to the great home market. It tells why every home should have a time switch to turn lights on at dusk to simulate occupancy and thereby ward off burglars.

WRITE FOR SAMPLES

of any or all of these helps and the name of the Inter-Matic Distributors in your territory.

NO COST — NO OBLIGATION

Ask for Full Information on the

INTER-MATIC

115 V., 60 C.

$9.00 LIST

50 cycle —$9.19
25 cycle — 9.32

F.O.B. Chicago

INTERNATIONAL REGISTER CO.

Dept. 27B, 2624 West Washington Blvd., Chicago 12, Illinois

Manufacturers News

G-E APPOINTMENTS

The General Electric Company has established an Affiliated Manufacturing Companies Department, and appointed Vice President L. R. Boulware as general manager. E. J. Harrington has been appointed manufacturing manager of the new department, and Roy W. Johnson marketing manager.

Mr. Boulware, who had been vice president on the president's staff, joined G-E following his wartime service with the War Production Board.

Mr. Johnson was vice president in charge of sales for Telechron, Inc. During the war he was with WPB, serving as director of the Facilities Bureau. Mr. Harrington has been on the staff

L. R. BOULWARE

R. W. JOHNSON

of Mr. Boulware since October, 1945.

The manufacturing affiliates include Carboloy Company, Inc., General Electric X-Ray Corporation, Hotpoint, Inc., Locke Insulator Corporation, the Monowatt Electric Corporation, Telechron Inc., and the Trumbull Electric Manufacturing Company.

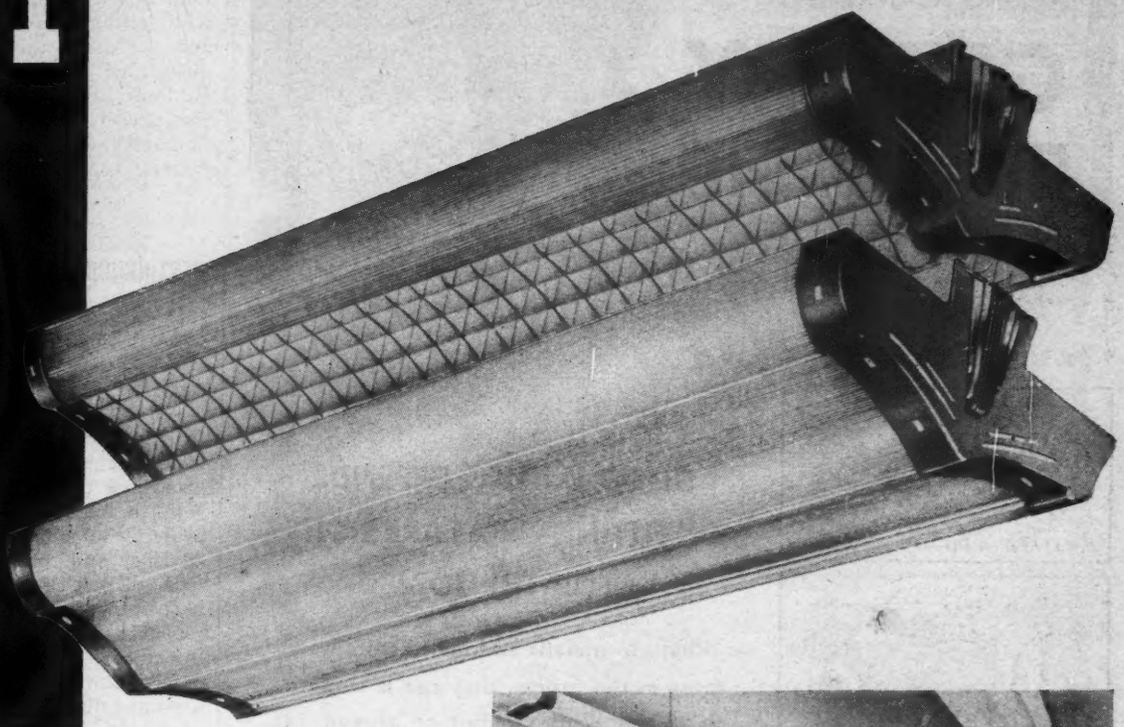
Horace Zimmer has been named manager of the apparatus department, New York District of the General Electric Company. Mr. Zimmer succeeds T. F. Barton, commercial vice president, who will devote full time to his duties as a member of the staff of Charles E. Wilson, president.

Four major organization changes

LPI

Constellation

STAR PERFORMER IN A BRILLIANT CAST



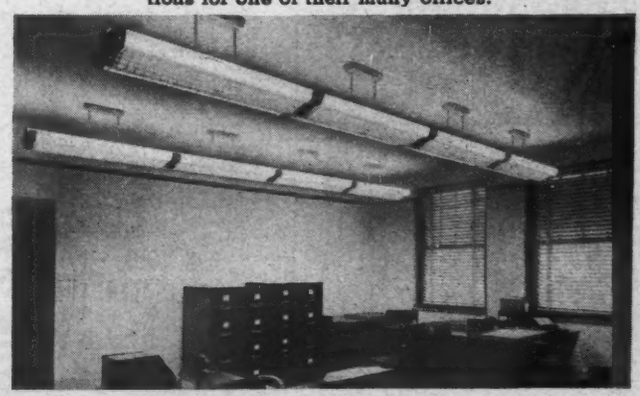
The Constellation keeps alive the LPI tradition of the best that's new in lighting. Here are functional beauty, engineering skill, and utility—all in one fine fluorescent fixture.

Constellations are available in two or four light, louvred bottom or all glass 40 watt units. They can be mounted singly or in continuous runs, and mounting—either on ceiling surface or from stem hangers—is a simple matter. Carefully designed housings include every necessary installation aid. Constellations are equipped with easy-to-use mounting plates and hangers, and readily understandable installation instructions are included in every Constellation carton.

LPI engineers have designed the Constellations to meet all specifications as recommended by the Utilities Research Laboratories.

Write today for your copy of the new 16 page Constellation brochure, LPI bulletin number 400.

(Above) —The Public Service Company of Northern Illinois chose glass bottom, four light, 40 watt Constellations for one of their many offices.



(Above) — Louvred Constellations brighten an office of the Public Service Company of Oklahoma.

LIGHTING PRODUCTS INC.
HIGHLAND PARK, ILLINOIS

They make tough jobs easy because

GEDNEY FITTINGS...FIT!

MALLEABLE IRON—RUGGED

SMOOTH INSIDE AND OUT!

BRIGHT FINISH— RUST PROOF

THREADS CLEAN—EASY TURNING

EASY TO INSTALL

A COMPLETE LINE

GOOD WIRING DEPENDS ON FITTINGS THAT ARE RIGHT FOR THE JOB!

What electricians and contractors want most in the fittings they use is smooth fit. They want conduit to thread in smoothly, caps to fit into place easily, screws to align and tighten evenly. With GEDNEY fittings the contractor knows his job will come out right. All GEDNEY fittings are packed in sturdy, metal-edged boxes that can't break open, and each package is clearly labeled for quick selection.

The fact that GEDNEY fittings have been on the "best seller" list with mechanics who know fine accessories is proof enough of year in—year out excellence. Check the other features in the panel at left. They highlight the points about GEDNEY fittings that mean money in the bank for "live wire" wiring men.

ASK YOUR WHOLESALER

WRITE FOR LITERATURE

GEDNEY ELECTRIC CO.

FOUNDRY, FACTORY & SHIPPING POINT: TERRYVILLE, CONN.

RKO BLDG., RADIO CITY, NEW YORK 20, N. Y.

have been made in the General Electric Lamp Department sales district setup. T. W. Moore, for many years manager of the department's Southeastern sales district and for more than 46 years with G-E, retired from active service. His district headquarters have been in Atlanta.

The Southeastern sales district has now been divided into two districts. One is called Carolina sales district with headquarters in Charlotte, N. C. and the other the Southeastern sales district with offices in Atlanta. Glenn E. Park has been named manager of the new Carolina district, and L. J. Campbell as manager of the new Southeastern sales district.

WESTINGHOUSE APPOINTMENTS

Dr. Charles M. Slack has been appointed director of research for the Westinghouse Lamp Division. He succeeds Dr. Harvey C. Rentschler, director of Westinghouse lamp and electronic tube research for the past 30 years. Dr. Rentschler, who is approaching retirement, will devote himself to completing certain research projects in addition to serving in an advisory and consulting capacity.

Dr. Slack joined the research department at the Bloomfield plant as a physicist in 1927 and became assistant director of research in 1943.

Dr. John W. Marden, who has been assistant director of research in charge of the development of rare metals, has been named manager of a newly-established molybdenum department at the Lamp Division.

Purchase of 27 acres in Little Rock, Ark., for construction of an incandescent lamp manufacturing plant has been announced by Ralph C. Stuart, vice president of the Westinghouse Electric Corporation.

FEDERAL ELECTRIC NAMES TWO VICE PRESIDENTS

Two new vice presidents, W. H. Lantz, Jr. of Hartford, and Rey F. Frenger of St. Louis, have been elected by the Board of Directors of Federal

W. H. LANTZ, JR.

Electric Products Company, Newark, N. J.

Mr. Lantz, who came to Federal in 1941, will be the executive head of

R. F. FRENGER

the Hartford division. Prior to assuming his new position, Mr. Lantz was general manager of the Hartford Division and from 1941 to 1945, he was chief engineer.

Mr. Frenger joined the company in August of this year and will be in charge of the Wm. Wurdack division in St. Louis. Mr. Frenger was formerly assistant to the vice president of the National Vulcanized Fibre Co., Wilmington, Del. and previous to that was with Westinghouse Electric Corp.

NEW OFFICERS FOR MASTERCRAFT

Mastercraft Electric Company, 181 Bruce Street, Newark, N. J., announces the election of new officers. Irving Skolnick, formerly vice president in charge of sales and advertising, is the new president and general manager.

Sidney Blackman is now vice president and will coordinate sales promotion, market research and production schedules. Mr. Blackman previously headed purchasing and production.

SYLVANIA APPOINTMENTS

Robert H. Bishop, director of sales, and Conda P. Boggs, director of manufacturing, were elected vice presidents of Sylvania Electric Products, Inc.

Mr. Bishop joined the company as a member of its New England sales force in 1936. He subsequently became New England district manager, eastern sales manager, and in 1943 general sales manager for all of the company's lighting products. Last April he was appointed director of sales for the entire company.

Mr. Boggs, who had been associated with General Electric and RCA, joined Sylvania in 1932. After special assignments in connection with costs and planning, he became assistant to the executive vice president in 1940, and was appointed director of manufacturing in 1942.

FULLMAN Latrobe PRODUCTS

FLOOR BOXES · WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

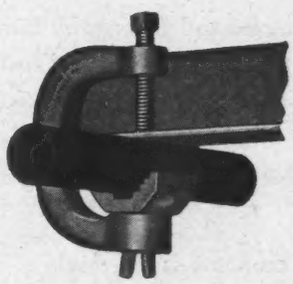
Latrobe Products are tops in quality, in performance and in point of economy. Quickness of installation saves valuable time.

No. 110 Non-adjustable Watertight Floor Box

Strong iron body with 3½" brass cover plate. Shown with No. 208 Receptacle and No. 207 Bell Nozzle.

No. 280 Nozzle with No. 200 Cover Plate

Ten Amp. 250 Volt Receptacle in Brass Housing, ½ in. brass extension.

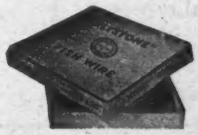


No. 470 "Bull Dog" Pipe or Conduit Hanger

Quick and convenient for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick. Used also as ground clamp.

"Bull Dog" Insulator Support

Used extensively for fastening porcelain or glass insulators to exposed steel work.



Keystone Fish Wire

Flat Steel properly tempered. Ten sizes. Coils from 100 ft. up.

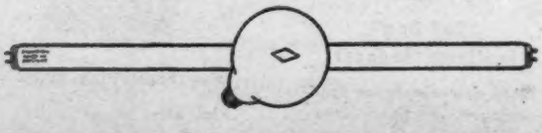
FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

with CHAMPIONS

CHAMPION Fluorescent and *Incandescent* Lamps are made and tested to provide the most efficient, low cost industrial light. Back of them is an organization of specialists in industrial lamp manufacture, with trained lighting experts in the field to give you dependable counsel on correct lighting for every part of your plant.

Champion Lamp economy is the result of careful teamwork by a manufacturing and distributing organization set up to get lamps to you at minimum cost. When you standardize on Champion Lamps you can be certain of getting the most lighting and lamps for your money.

May we put you in touch with the Champion distributor in your locality?



CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.

Charles H. Goddard, assistant general sales manager of the Lighting Division, has been appointed general manager of the fluorescent fixture division. He will make his headquarters at the Ipswich, Mass. plant. Mr. Goddard joined Sylvania in 1944 as

R. H. BISHOP

C. H. GODDARD

merchandise manager of the fluorescent fixture division. Prior to joining Sylvania, Mr. Goddard was vice president of the Pittsburgh Reflector Co.

S. B. Williams has been named manager of customer relations for the Lighting Division. For the past eight years he has been editor of *Electrical World,* and had previously been as-

S. B. WILLIAMS

sistant managing editor and managing editor. Mr. Williams is a member and a past president of the I.E.S.; a member of the A.I.E.E. Since 1943 he has served as secretary of the Committee of Awards for the James H. McGraw Awards for Electrical Men.

OKONITE COMPANY CHANGES

R. S. Keefer, formerly sales manager, has been appointed vice president in charge of sales and will be responsible for directing all sales activities of The

R. S. KEEFER

Okonite Company, Passaic, N. J. and its Hazard Insulated Wire Works Division, as well as those of its affiliate, the Okonite-Callender Cable Co., Inc.

F. E. Bankwitz has been appointed manager of Okonite's Washington office, to replace R. Soutter who has been granted a leave of absence effective March 1.

D. W. Nurse, formerly of the San Francisco office of The Okonite Company, is now manager of the Portland office.

W. R. Van Steenburgh is manager of Okonite's New York territory, in addition to his duties as manager of the company's light and power department.

BRIGHT LIGHT REPRESENTATIVES

Bright Light Reflector Company, Bridgeport, Conn. announces the appointment of the following sales representatives:

The Frank H. Brand Company in Los Angeles and San Francisco will cover the states of California, Arizona, and Nevada and the territory of Hawaii.

J. Stanley Dunlop of Baltimore, Md. will cover the state of Maryland and Washington, D. C.

Searls Brothers, Chicago will cover the state of Illinois and the southern part of Wisconsin. Searls Brothers of Kansas City, Mo. will take care of the states of Iowa and Nebraska.

WESTINGHOUSE SUPPLY CHANGES

W. B. Meek, former assistant general manager of the Westinghouse Electric Supply Company, New York, has been appointed district manager of the Wesco West Central district with headquarters at Columbus, Ohio, succeeding the late E. M. McAfee.

C. E. Apps has been named ap-

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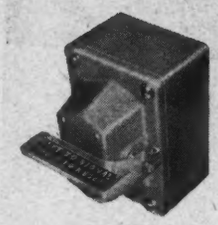
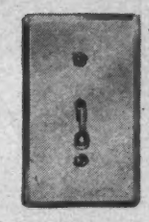
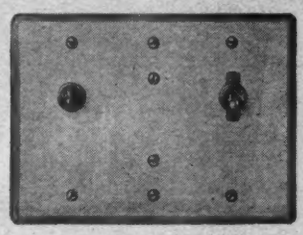
HOSPITAL SIGNAL SYSTEMS BY CANNON ELECTRIC



HMEP—Explosionproof Hospital Switch

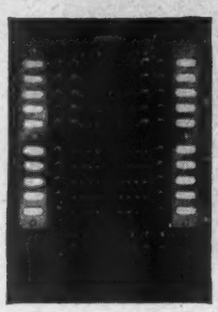


HMVP—Vaporproof Hospital Switch

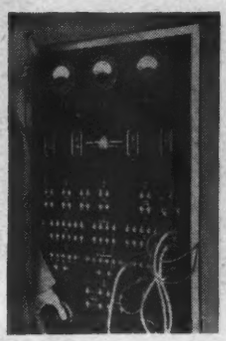


Nurses' Supervisory Station SUP-1

MISCELLANEOUS ITEMS BY CANNON ELECTRIC



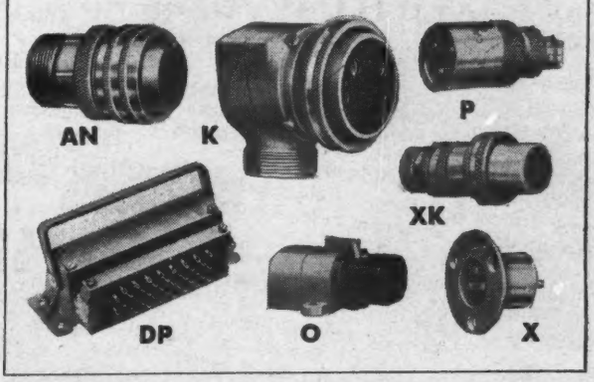
Program Bell Transfer Panels for schools and institutions for calling classes and special programming. Built in various sizes and combinations.



Experimental Laboratory Switchboards for schools and research institutions are built to meet customer specifications.

Cannon Electric Type "X" Plugs and Receptacles are particularly adapted to inter-communication phones such as shown above.

LEADING TYPES OF CANNON ELECTRIC CONNECTORS



For a summary of the majority of Cannon Electric multi-contact connectors and specialty items with prices, write for Bulletin No. C-46-A. Address Catalog Department B-231.

CANNON ELECTRIC

CANNON ELECTRIC DEVELOPMENT COMPANY

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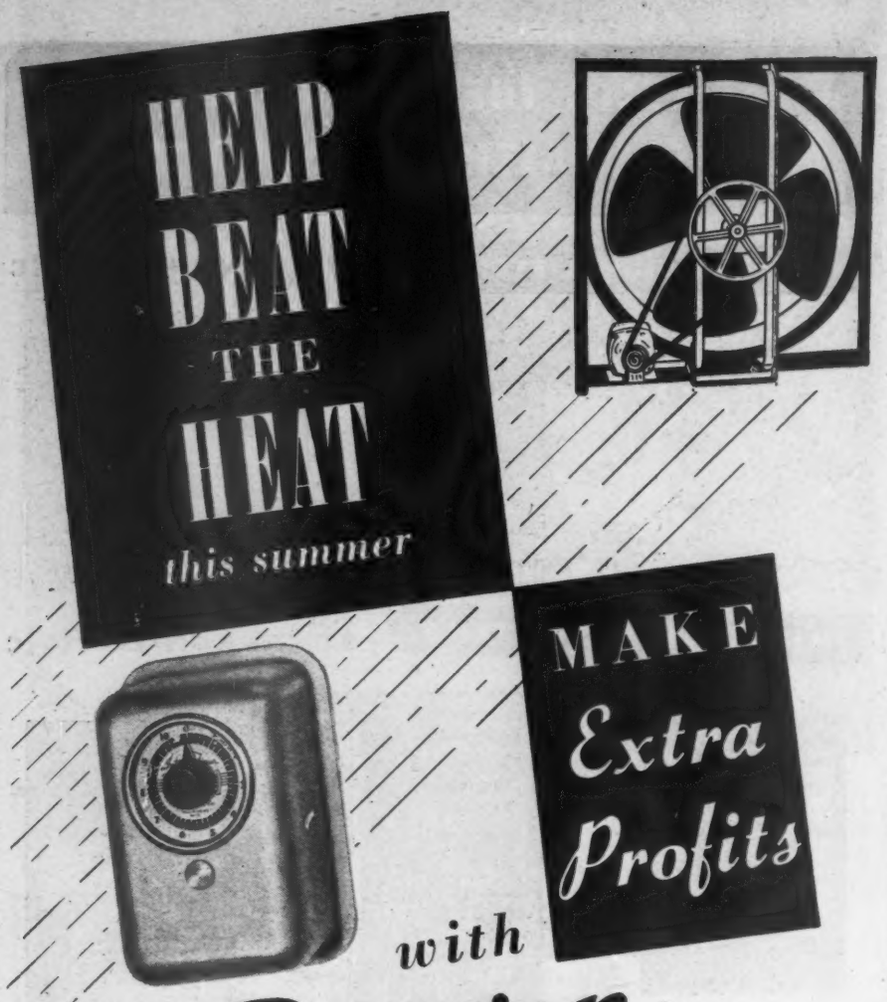
Canada & British Empire—Cannon Electric Co., Ltd., Toronto, Ontario • World Export Agents (excepting British Empire) Frazar & Hansen, 301 Clay St., San Francisco 11, Calif.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BEAT
THE
HEAT
this summer
MAKE
Extra
Profits
with
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Timers for attic and window fans
Thousands of homes have attic and window fans . . . still others will have them.
You can make extra profits by helping these homes "Beat the Heat," with Paragon AF Timers to control the fans. Provides extra comfort and convenience. Preset, these timers control the fans automatically, for any period, up to 20 hours.
Work with all A.C. fans . . . Telechron motored (QUIET), handsomely finished drawn aluminum case . . . dial and pointer protected with clear Plastacele.
Timer motor runs only when timer is operating the fan. Setting may be changed at any time without harming the timer. Dial graduations plainly marked for easy setting. Lists at only $9.75 . . . worth that in one season . . . good for many many years.
Leading jobbers stock attic fan timers by Paragon . . . maker of "A Timer For Every Need."
$9.75 list price
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Paragon Two Rivers WISCONSIN
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paratus and supplies manager of the Miami branch. He was formerly a sales specialist in that branch.

Gus A. Bremer, Jr. has been appointed lighting specialist of the St. Louis branch, succeeding T. P. Gleeson who is retiring. Mr. Bremer has been Mr. Gleeson's assistant since September 1945.

ALLIS-CHALMERS APPOINTMENTS

R. T. Stafford has been named as assistant to Vice President W. C. Johnson, and J. W. McMullen as general manager of the Pittsburgh Works of the Allis-Chalmers Mfg. Co. D. G. McArn continues as works manager of the Pittsburgh plant.

Paul R. Pollock has been named manager of the Denver, Colo. office. Henry H. Roth, whom Mr. Pollock succeeds at Denver, has been transferred to generator sales of the motor general sales section of the electrical department at the company's main works in West Allis, Wis.

E. T. Cuddeback, who spent nearly five years in the U. S. Army Air Forces and was released as a lieutenant colonel, is now representing Allis-Chalmers out of the district office in Atlanta, Ga.

•

The Electric Products Company, Cleveland, announces the appointment of The Udylite Corporation of Detroit as distributor of electrolytic motor generators.

•

The Burndy Engineering Co. has opened a new factory and warehouse in Vernon, Calif. This plant is under the supervision of Lawrence Lyons, formerly a member of the field engineering staff of the company. He will be assisted by Keith Messent, formerly associated with International General Electric Co. and F. C. Huyck & Sons.

There is no change in the company's sales organization which includes these representatives, Earl S. Condon Company, Los Angeles; George E. Honn Company, San Francisco; F. W. Carlson, Seattle and Portland; Riter Engineering, Salt Lake City and Peterson Company, Denver.

•

The Feedrail Corporation, 125 Barclay St., New York, announces the appointment of Edward W. Kelly as New England representative. He will maintain offices at 470 Statler Building, Boston, Mass.

The Cleveland sales office of Feedrail has expanded to include Paul S. Wagner and Raymond N. Green, Wagner-Green Company, of which their former representative, Robert J. Nelson, is now an associate. Their office is located at 1935 Euclid Avenue.

FLOW LINES IN SHOWROOM LIGHTING

[FROM PAGE 53]

intensity (50 watts per linear foot per band), diffused, white (3500 degrees) light. Containing five rows of fluorescent lamps, each band (detail B) is 14 inches in width. Since both the overhead circles and the salon-framing illuminated cornice parallel the path of the moving cars, the dominant reflected lines of light are principally longitudinal, accentuating the length of the streamlined cars and adding sparkle and lustre to the polished metal. Recessed into the inclined ceiling above the escalators, a 4-lamp concave troffer (detail C) points from the main salon to the second floor car display. Beneath the escalator an 8-foot 3-lamp curved glass fixture (detail G) continues the motif of the cornice treatment (interrupted by the escalator ramp) and illuminates a Chrysler wall display.

Located between four structural columns in the northern section of the showroom, two 8-foot and two 12-foot fixtures (detail D) direct light downwards to a seventh car on display. Although the special glass panel is mounted flush with the ceiling, the four fluorescent rows of lamps in each troffer are inclined and reflectors are designed to direct light inward towards the car. While highlighting the display, the slight inclination adds to the vertical component which, augmented by illumination from the combination air-light cornice, creates strong accents for sides and wheels.

At the lobby end of the salon, behind a curved structural hanging cornice and behind a segmented curtain of glass and glass block, a triangular 2-lamp design (detail E) provides illumination for an information desk and a curved, recessed, continuous, two-lamp troffer (cross section also similar to detail E) lights entrances and windows facing the lobby. Fixture F, mounted over the corner lobby window, furnishes an example of close-quarter installation. Cramped by structural limitations, this 9-foot (7 by 7-inch cross section) troffer is supported by lever lugs and houses six 36-inch 30-watt fluorescents (two rows, 3 lamps per row).

Among several types of lighting equipment installed in the second floor showroom, two designs, are particularly noteworthy. The first is a decorative, octagonal, flat-domed fixture recessed into the ceiling of the entrance

SOLDERLESS—TAPELESS
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SOLAR
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Solar SCRU-ITS are used for connecting two or more wires without tape, solder, flame or tools. They are economical and easy to use—wire ends are stripped and SCRU-ITS screw right on to form a compact and efficient joint.

SCRU-ITS give better mechanical and electrical contact . . . eliminate possibilities of shorts, grounding and corrosion. Their compact size permits their use where working space is at a minimum.

Available in several sizes for connecting various combinations of wires.

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3. THAT'S IT with SCRU-ITS!

DON'T TAPE
DON'T SOLDER
"SCRU-IT"!

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MILLIONS IN USE • HUNDREDS OF APPLICATIONS

"Roughing-in" or permanent wiring is simplified with SCRU-ITS . . . they thread on with a twist of the wrist . . . and the joint is complete!

- Fixtures
- Outlet Boxes
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- Panel Boards
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- Motor Connections

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U. S. PATENT NO. 1,933,555

Write for Data Sheet U-2.

For complete specifications on SCRU-IT sizes, uses, prices, etc., WRITE TODAY.

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Every motor repair shop needs this catalog. It helps you determine the catalog number and price of Wagner fast-moving motor parts. Write for Catalog MU-40 today. M47-12

Wagner Electric Corporation

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lobby (detail H). Series of 24-inch 20-watt fluorescent lamps are mounted in an inclined, radiating pattern behind the light-diffusing glass panels with closely-spaced horizontal lamps illuminating the central section. Flush-mounted truncated glass panels flank this central dome and blend the design into a recessed, 2-lamp troffer which stretches from the top of the escalator to the upper showroom.

The second floor salon is illuminated primarily by parallel rows of continuous three-lamp troffers (detail J) with shallow inverted V, specially designed glass panels. The inverted V accomplishes two objectives. Due to construction, direct and internally-reflected light is transmitted over a greater area, with a noticeable tendency for the light rays to hug the ceiling. Walls are illuminated nearly to ceiling level and vertical surfaces of displayed cars receive a high component of the effective light. Readings taken a month after installation indicated an average horizontal-plane hood-high intensity of 51 footcandles while readings on vertical surfaces averaged 40 percent of this figure. These intensities duplicate the results obtained in the main salon where dispersion due to greater mounting heights is offset by increases in wattage per fixture. Directly beneath these inverted V fixtures, also duplicating the results obtained directly beneath the concentric bands of light over the main salon turntable, readings climb to 75 footcandles. The second objective accomplished is to increase the apparent height of the room. Looking upwards, the eye is unconsciously drawn above the actual ceiling line because the lighted panels give the same impression as vaulted arches.

Executive offices and small conference rooms on the second floor are lighted by both incandescent luminaires (detail K) and 4-lamp fluorescent fixtures (detail L). Both units are decorative, the incandescent fixture, flush mounted, housing a 150-watt PS bulb in a cast-bronze frosted-glass beveled square—and the fluorescent installation, with four rows of 40-watt T-12s, partially recessed with lamps mounted in the approximate plane of the ceiling.

In the two-floor installation, 1673 fluorescent lamps are used with units of 14, 15, 20, 30 and 40 watts), totaling 5667 feet in length and exceeding 68 kw. in hourly lighting consumption. Credit for the conception, creation and installation of the lighting plan goes to Edward F. Caldwell & Co., N.Y.C.

VETERANS TRAIN FOR ELECTRICAL WORK

[FROM PAGE 62]

necessary qualifications. Veterans who expect government aid throughout the four years' training should have at least three years military service. Otherwise, the government aid (one year's aid for *any* service, plus one year's aid for each year of service) will expire ahead of completion of the course.

Many of the first apprentices were referred to Stark Electric Company for registration in this course by local Selective Service draft boards. The company runs advertisements in the local newspapers periodically, which also attracts some students. However, the majority of apprentices are now referred to the course by the vocational adviser of the Veterans Administration.

First Year Class

A company employee who is an ace trouble shooter, with special aptitude for teaching practical electrical applications, teaches the first year class. No typical textbooks are used (see "First Year Curriculum"). A blackboard is used for showing wiring diagrams, connections, charts and simple illustrations. Units of equipment being studied at each class are taken from the stockroom, so that students can easily relate actual equipment to the discussion in the classroom. In place of normal textbooks, the instructor and students use catalogs, charts and trade literature. This gives students first hand knowledge of the types and sizes, ratings, etc., of the equipment under study. It also gives them an opportunity to discuss the usual faults of the equipment, and service methods used to correct the faults. A typical catalog used is the Westinghouse Quick Selector, listing safety switches, nofuse breakers, multi-breakers, panelboards, motor controls and motors. Typical charts used are "Check Charts for Trouble Shooting", clipped from *Electrical Contracting* over the past several years. This emphasis upon apparatus, application and installation enables students to obtain visual and *related* training at the same time. They learn how to start a motor repair job, and to carry it through, step by step, to final test.

Second Year Class

The main subjects studied by the second year class are the National

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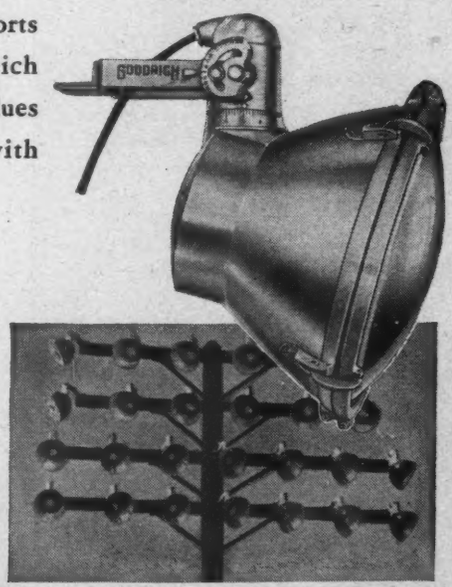

Complete Engineering Service

Goodrich illuminating engineers will be glad to study your floodlighting problems, recommend the proper equipment for specific needs, make lighting layouts, etc. This assistance is yours without obligation.

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A size and type for every purpose

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All Voltages

Single phase and poly-phase

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Single Phase
460/230 to
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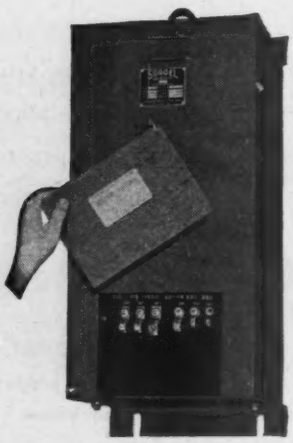
Describing and Illustrating our latest and most complete line of Air-Cooled Transformers

5 KVA
Wall Mounting Type

50 KVA. Single phase.
Floor Mounting Type.
With cover of connection compartment removed, showing solderless terminals.



15 KVA. 3-phase.
Wall mounting type.
Showing connection compartment with solderless terminals

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wisconsin

Pioneers in the development and manufacturing of Air-Cooled Transformers

Electrical Code, some basic electrical laws and formulas, blueprint reading, and solving of typical wiring problems (see "Second Year Curriculum"). Instructor for this class is Wm. H. Miller, Superintendent, Electrical Inspection Department, Association of Fire Underwriters of Baltimore. He is an authority on the National Electrical Code, and has taught in Baltimore's city vocational schools for a number of years. Students in this class are well qualified to take up code and related problems, because of the practical experience gained about equipment and its application while taking the first year course.

Third and fourth year class curricula are now in preparation. In general, it is planned to teach simple mathematics, fundamentals of electrical theory, and practical phases of electrical engineering. All class instruction and practical work assigned to students will continue to be related.

The training approach used in this program reverses the normal trend in formal vocational and engineering schools. The preliminary training over the first two years is of a practical nature, and does not involve complicated theory and mathematics. This approach equips apprentices to take on normal problems which would be considered mental hazards without such preliminary training. Upon completion of the full course, apprentices will be capable general industrial electrical mechanics, and ace trouble shooters, well qualified to handle all normal electrical installation, maintenance and repair problems quickly and efficiently.

The advantages gained from this course are many. The apprentice obtains definite tangible results. He gets training in four years which is equivalent to normal ten years experience, and thus gets a head start of five or six years over non-trained students. He performs useful work for which he is paid while learning and is equipped for employment throughout life.

The company also benefits from this training program. The program insures well trained employees to handle their work at all times, and eliminates the problem of lack of mechanics, or of use of untrained personnel. Customers get better work, thus become better customers. The confidence of customers is built up through well trained, efficient mechanics, who do work in a minimum length of time. This enables customers to keep production lines running with very little delay, thus saving them money.